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The Interaction Effect of Humic Substances and Mineral Phosphorus Fertilization on Forage Yield and some Macronutrients Uptake of Triticale under different Soil Salinity Levels.

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ABSTRACT

Salinity becomes one of the most important and serious agricultural problems. Furthermore, it is an ever-present impendence to crop productivity, especially in the countries where irrigation is a determining factor for agricultural activity. It is known that crop matching is one of the ways to overcome the problem of soil salinity, such as triticale plant which was recognized as a crop suitable for growth in saline soils. Two field trials were conducted to study the interaction effect of soil salinity levels, Humic substances and mineral phosphorus fertilization, it can further illustrate how triticale cultivation in saline soils is developed by studying the impact on plant height, forage fresh and dry weight, total NPK uptake in dry forage. All privies parameters were depressed with increased salinity levels. While the order of Humic substances for their influences on triticale growth parameters and total N, P and K uptake were as follows: Falvic soil, Falvic foliar, Humic soil, Humic foliar, without Humic substances. While, applying 140 kg P ha^{-1} gave the highest results of previous parameters. While the interaction effect shows that when using 70 kg p ha^{-1} in low soil salinity (SL), or when using 140 kg p ha^{-1} in moderate soil salinity (SM), the effect of Humic substances will become clear on fresh and dry forage yield and total N, P and K uptake of triticale. Therefore, it is preferred that applying Humic substances and mineral phosphorus fertilization to the improvement of triticale production with increasing soil salinity.

***Keywords**:* Triticale, Humic substances, Fulvic, mineral phosphorus, nitrogen, potassium, uptake

INTRODUCTION

Soil salinity considers as one of the major environmental abiotic stresses in the world that limit agricultural productivity and food supply. Salt in soil and water restrains plant growth for two causes. First, soil salinity reduces the ability of plants to water uptake by the osmotic or water deficit effect of salinity. Second, it may enter the transpiration stream and subsequently wound cells in the transpiring leaves, this is the salt-specific or ion-excess effect of salinity (Munns and Tester, 2008; Parihar *et al.*, 2014), resulting in a loss of yield of 20 to 50% (Shrivastava and Kumar, 2015).

Triticale is a new cereal which has been produced by crossing wheat and rye grass. Over years thanks to research and breeding, it has become an important small grain addition to the agricultural repertoire designed to cope with the needs of many regions of the world for feed, forage, and sustainable cropping systems (Arseniuk, 2015).

Humic substances are natural organic compounds, comprising a complicated array of molecules of relatively low molecular weight bounded by van Der Waals forces, p – p, CH-p and hydrogen bonds (Piccolo 2002; Colombo *et al.*, 2015; Shen *et al.*, 2016). Humic substances are physiologically active on soil and plant growth due to their complex structure rich in organic content. Several investigations suggested the beneficial effect of using Humic substances in agricultural systems including reducing mineral fertilizers application, increasing of fertilizers use efficiency, increasing of plant tolerance against environmental stresses, reducing the hazardous effect of plant pathogens, stimulating early growth and maximizing the produced yield (Denre *et al.*, 2014).

Phosphorus (P) is an essential macro-nutrient required for many functions in the plant, involving energy production, nucleic acid synthesis, glycolysis, photosynthesis, respiration, membrane synthesis and stability, enzyme activation/ inactivation, signaling, redox reactions, and carbohydrate metabolism (Vance *et al.*, 2003).

So it was suggested to study the interaction effect of soil salinity levels, Humic substances and mineral phosphorus fertilization, it can further illustrate how triticale cultivation in saline soils is developed by studying the impact on plant height, forage fresh and dry weight, total NPK uptake in dry forage.

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MATERIALS AND METHODS

Description of the experimental site and climate

Field experiments were conducted for two winter seasons (2017-18 and 2018-19) to study the effect of Humic substances and mineral phosphorus fertilization on forage yield, some macronutrients uptake and phosphorus use efficiency of triticale under three different locations in salinity at the experimental farm of El-Serw Agriculture Research Station, Agriculture Research Center, Damietta governorate (31°14′N and 31°48′E) in the Northern Egypt.

Soil samples EC was determined for the surface layer in 1:5 soil water extract and measured by dSm^{-1} at 25 C as follows:

The first location salinity level (SL) were 3.5 and 3.2 dSm^{-1} as average for the first and second seasons, respectively. While, the second location salinity level (SM) were 6.00 and 5.55 dSm^{-1} as average for the first and second seasons, respectively. But, the third location salinity levels (SH) were 11.30 and 10.65 dSm^{-1} as average for the first and second seasons, respectively.

Irrigation from El-Serw drainage from a point away from the start of the drainage about 20 km (EC 3.2:3.3 ds m-1, SAR 10.5:11.3), therefore it's considered to cause increase salinity problems (Tagour and Mosaad, 2017). The region has a sub-tropical climate with hot, dry summers and cool wet winters. The weather conditions (average precipitation (mm), humidity percentage, maximum - minimum temperature and Dew/Forest Point C°) at the experimental location during triticale growing seasons were quite variable in the two years of experimentation (Fig. 1):

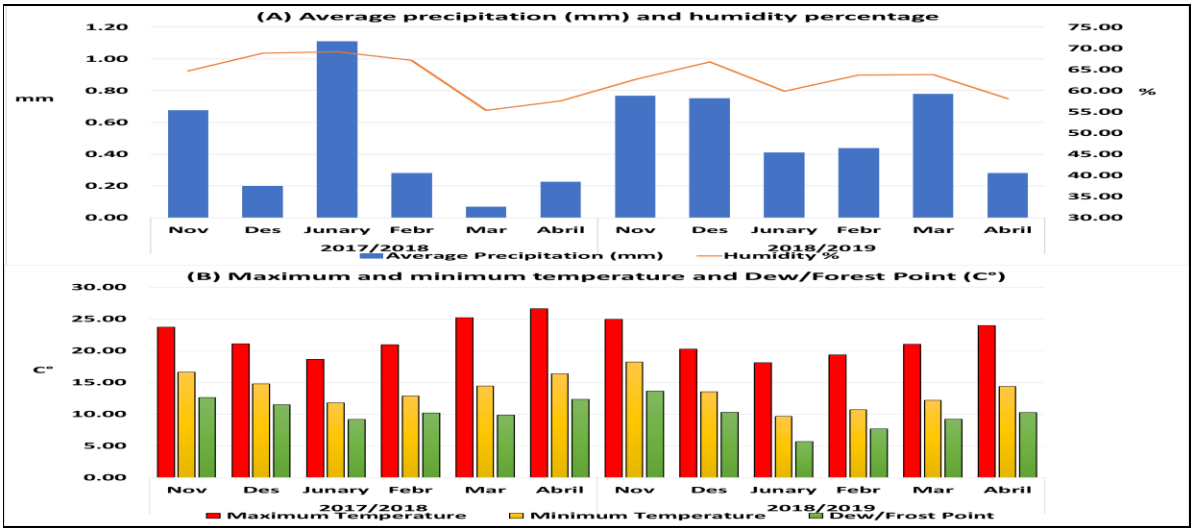

Fig. 1. (A) average precipitation (mm) and humidity percentage and (B) maximum - minimum temperature and Dew/Forest Point (C°) of experimental sites during winter seasons at 2017-18 and 2018-19.

Experimental treatments and crop management

A split plot design with four replicates was used where the main plots were arranged to study the effect of Humic substances (A0, H1, H2, F1 and F2), where A0 stands for control without Humic substances, H1 indicates to Humic foliar application at 7.15 kg ha-1, H2 refers to Humic in-soil application at 28.6 kg ha-1, F1 indicates to Falvic foliar application at 7.15 kg ha-1 and F2 indicates to Falvic in-soil application at 28.6 kg ha-1. Whilst, mineral of phosphorus fertilization rates were 0, 70, and 140 kg P ha-1 as calcium super phosphate (6.8 P) occupied the sub plots. The plot size was 16 m2 (4m x 4m). Triticale (X Triticosecale Wittmack. Seeds of triticale was introduced from forage Research Department, Agriculture Research Center, Egypt. All the recommended practices for planting was don according to Agriculture Research Center.

The first winter season 2017-18, triticale was sown in 15th November 2017, when the last cut was in 14th April 2018. While triticale in the second winter season 2018-19 was sown 12th November 2018 and the last cut was in 11th April 2019.

Triticale growth parameters and forage yield

Plant height (cm), fresh forage yield (t ha-1) and dry forage yield (t ha-1) of triticale plant were recorded at the time of each cut, then average of three cuts were calculated.

The 1st cut was taken after 60 days from planting, the 2nd cut was done after 45 days after the 1st cut, while the 3rd cut was taken after 45 after the 2nd cut. Forage yield was estimated by cutting triticale 10 cm from soil surface.

Plant height determined from soil surface until upper tipe of plant. While fresh forage yield determined by weighting of cutting triticale for the experimental plot size then converted to t ha-1. Dry forage yield determined by drying all cuts for area 1 m2 in an oven at 70 °C until weight constancy.

Total nitrogen, Phosphorus and potassium uptake

Samples randomize of triticale cuts were oven-dried at 65°C for 48 h to a constant weight and ground to pass through a 0.5 mm screen. Total N content was determined by Micro-Kjeldahl method (Westerman, 1990). While total phosphorus and potassium in plant were Chemically analyzed according to Mertens (2005a, b) methods and Agrilasa (2002).

Total nutrient element uptake was determined as:

Total nutrient element uptake = (Total nutrient element % × dry forage yield $^{(kg}$ ha$^{-1)}$)/100

The statistical analysis:

Data were collected for statistical analysis according to Snedecor and Cochran (1981). Mean values were compared, at a level of P<0.05 by using the Least Significance Difference (LSD) test. CoStat (v. 6.400 CoHort software., California, USA) was used for statistical analysis for data.

RESULTS AND DISCUSSION

Growth characters:

According to the data contained in the Tables 1,2 and 3, plant height, fresh and dry weight of triticale plant were depressed with increased salinity levels during both seasons and in pooled analysis. Actually high soil salinity has three potential effects on plants: lowering of the potential water, direct toxicity of Na+ and Cl- and the uptake of essential nutrients. Effects of salinity are more obvious in arid and semiarid regions where limited rainfall, high evapotranspiration, and high temperature associated with poor water and soil management practices are the major contributing factors. Grattan and Grieve (1999) declared that soil salinity has negative effects on plant growth which is reduced in salt affected soil because of the excess uptake of potentially toxic ions. The general effects of soil salinity on plants are called a physiological drought effects. Actually salinity stress affects plant growth, development, and metabolism in many different ways. Excessive salt causes ion toxicity inside the cell, high concentrations of salt in the root medium, creates hyper osmotic stress that impedes water absorption and transport. Secondary stresses such as nutritional imbalance and oxidative stress often occur as a consequence of ion toxicity and hyperosmotic stress (Zhu, 2001; Zhu, 2003).

On the contrary, triticale growth parameters which were showed in Tables 1, 2 and 3 were also, highly significantly ($p<0.01$) increased with Humic substances in all seasons and pooled analysis. A positive result was noticed in triticale growth parameters by the use of Humic substances. Indeed, Humic substances have direct and indirect effects on plant growth. The direct effects are those that require the uptake of Humic substances into the plant tissue resulting in various biochemical outcomes, but the indirect effects involve the improvement of soil properties Tan (2003) and Sangeetha *et al.* (2006). The order of different types of Humic substances for their influences on triticale growth parameters were as follows: Falvic soil application > Falvic foliar application > Humic soil application > Humic foliar application > without Humic substances. The varied effects of different types Humic substances are attributed to the difference of its nutrients contents, its ability to improving soil properties. Al-Jumaily (2016) showed that all application methods of the Humic acid caused in a significant increase in most of parameters used and mix application (land+foliar) have surpass in plant height and straw yield of barley crop.

Table 1. Effect of humic substances and mineral phosphorus fertilization on plant height (cm) of triticale under different soil salinity levels.

Treatments	1st				2nd				Pooled analysis			
	Soil Salinity (S. S.)											
	SL	SM	SH	Total	SL	SM	SH	Total	SL	SM	SH	Total
					Humic substances (H. S.)							
A0	70.02	69.75	54.28	64.68	71.38	70.97	55.16	65.84	70.71	70.36	54.72	65.26
H1	85.22	83.68	68.19	79.03	86.73	85.26	69.45	80.48	85.98	84.47	68.82	79.76
H2	85.59	83.63	66.49	78.57	87.27	85.22	67.77	80.09	86.43	84.42	67.13	79.33
F1	88.59	86.29	68.78	81.22	90.17	87.83	70.05	82.68	89.38	87.06	69.41	81.95
F2	90.45	88.61	70.21	83.09	92.14	90.31	71.51	84.65	91.29	89.46	70.86	83.87
Total	83.97	82.39	65.59	77.32	85.54	83.92	66.79	78.75	84.76	83.15	66.19	78.03
LSD 0.05		**0.21				0.22**				0.21**		
					Mineral Phosphor fertilization (Ph. F.)							
P0	72.96	71.48	56.96	67.14	77.53	75.98	60.52	71.35	75.25	73.73	58.74	69.24
P70	84.28	82.74	66.06	77.69	84.30	82.74	66.05	77.70	84.29	82.74	66.06	77.70
P140	94.68	92.95	73.75	87.13	94.78	93.04	73.79	87.20	94.74	92.99	73.77	87.17
Total	83.97	82.39	65.59	77.32	85.54	83.92	66.79	78.75	84.76	83.15	66.19	78.03
LSD 0.05		0.13**				0.12**				0.11**		
H.S. × Ph. F.		ns				ns				ns		

Table 2. Effect of humic substances and mineral phosphorus fertilization on fresh forage yield (t ha^{-1}) of triticale under different soil salinity levels.

Treatments	1st				2nd				Pooled analysis			
	Soil Salinity (S. S.)											
	SL	SM	SH	Total	SL	SM	SH	Total	SL	SM	SH	Total
					Humic substances (H. S.)							
A0	22.16	14.94	6.58	14.56	24.57	15.89	6.62	15.69	23.36	15.41	6.60	15.13
H1	23.89	15.68	6.71	15.43	26.42	16.70	6.75	16.62	25.15	16.19	6.73	16.02
H2	23.24	14.98	6.63	14.95	25.72	15.96	6.64	16.11	24.48	15.47	6.63	15.53
F1	25.01	15.66	6.91	15.86	27.66	16.67	6.98	17.11	26.34	16.17	6.94	16.48
F2	24.96	17.00	7.55	16.50	27.62	18.11	7.58	17.77	26.29	17.56	7.56	17.14
Total	23.85	15.65	6.88	15.46	26.40	16.67	6.92	16.66	25.12	16.16	6.90	16.06
LSD 0.05		0.13**				0.14**				0.13**		
					Mineral Phosphor fertilization (Ph. F.)							
P0	20.19	12.41	5.97	12.86	22.86	13.54	6.14	14.18	21.53	12.98	6.06	13.52
P70	24.04	16.15	7.02	15.74	26.50	17.15	7.05	16.90	25.27	16.65	7.03	16.32
P140	27.32	18.39	7.63	17.78	29.83	19.32	7.56	18.90	28.57	18.86	7.60	18.34
Total	23.85	15.65	6.88	15.46	26.40	16.67	6.92	16.66	25.12	16.16	6.90	16.06
LSD 0.05		0.10**				0.10**				0.10**		
H.S. × Ph. F.		*				*				*		

Table 3. Effect of humic substances and mineral phosphorus fertilization on dry forage yield (t ha^{-1}) of triticale under different soil salinity levels.

Treatments	1st				2nd				Pooled analysis			
	Soil Salinity (S. S.)											
	SL	SM	SH	Total	SL	SM	SH	Total	SL	SM	SH	Total
	Humic substances (H. S.)											
A0	7.13	6.18	3.65	5.65	7.92	6.63	3.76	6.10	7.53	6.40	3.70	5.88
H1	7.49	6.69	3.94	6.04	8.34	7.18	4.07	6.53	7.92	6.94	4.01	6.29
H2	7.16	6.47	3.82	5.82	7.98	6.94	3.94	6.29	7.57	6.70	3.88	6.05
F1	7.84	6.97	3.79	6.20	8.72	7.48	3.92	6.70	8.28	7.22	3.85	6.45
F2	8.13	6.88	3.98	6.33	9.06	7.38	4.10	6.84	8.59	7.13	4.05	6.59
Total	7.55	6.64	3.83	6.01	8.40	7.12	3.96	6.49	7.98	6.88	3.90	6.25
LSD 0.05	0.01**				0.02**				0.02**			
	Mineral Phosphor fertilization (Ph. F.)											
P0	5.88	5.54	3.22	4.88	6.82	6.19	3.41	5.48	6.35	5.86	3.32	5.18
P70	7.93	6.71	3.90	6.18	8.74	7.12	3.99	6.62	8.34	6.92	3.94	6.40
P140	8.85	7.66	4.38	6.96	9.64	8.04	4.48	7.39	9.25	7.85	4.43	7.18
Total	7.55	6.64	3.83	6.01	8.40	7.12	3.96	6.49	7.98	6.88	3.90	6.25
LSD 0.05	0.02**				0.02**				0.02**			
H.S. × Ph. F.	*				*				*			

Also, data in Tables 1, 2 and 3 showed that triticale growth parameters were also, highly significantly ($p<0.01$) increased by mineral phosphorus fertilization in all seasons and pooled analysis. The highest values of triticale growth parameters were obtained with 140 kg P ha^{-1} following by 70 kg P ha^{-1}. Sufficient nutrition of triticale with phosphorus and potassium plays an important role in securing accomplishment of yields close to potential. Both elements fulfill important physiological functions in the plant by taking part in the processes of photosynthesis, transportation of assimilates and protein synthesis (Marschner, 1995).

Data in Table 2 and 3 explicates the effect of interaction between Humic substances and phosphorus fertilization under different soil salinity levels was a significant ($p<0.05$) on triticale fresh and dry forage yield in both season and pooled analysis. Moreover, the interaction plot of mean of fresh and dry forage yield by the interaction between Humic substances and phosphorus fertilization was explaining in Fig. 2, and 3, respectively. Figure 2 showed that the effect of Falvic foliar application following by Falvic soil application, Humic soil application and without Humic substances, respectively on fresh forage yield of triticale were the highest with low soil salinity level when use 140 kg P ha^{-1}. But when using 70 kg P ha^{-1} in phosphate fertilization of triticale in low soil salinity (SL), or when using 140 kg P ha^{-1} in phosphate fertilization of triticale in moderate soil salinity (SM), the effect of Humic substances will become clear on fresh forage yield of triticale. While Fig. 3 indicated that the effect of Falvic foliar application following by Falvic soil application, without Humic substances and Humic soil application, respectively on triticale dry forage yield were the highest with low soil salinity level when use 140 kg P ha^{-1}. Also, just like in fresh forage yield when using 70 kg P ha^{-1} in phosphate fertilization of triticale in low soil salinity (SL), or when using 140 kg P ha^{-1} in phosphate fertilization of triticale in moderate soil salinity (SM), the effect of Humic substances will become clear on dry forage yield of triticale.

Salinity becomes one of the most important and serious agricultural problems. Moreover, it is an ever-present threat to crop productivity (Montesano and Iersel, 2007; Rasool *et al.*, 2013), therefore supporting crops with materials that can give them salt tolerance is one of the most important challenges facing agriculture in saline soils. These materials include phosphate fertilizers (Bargaz *et al.*, 2016) and Humic substances (Çimrin *et al.*, 2010; Aydin, 2012). This is illustrated by the results of Figures 2 and 3

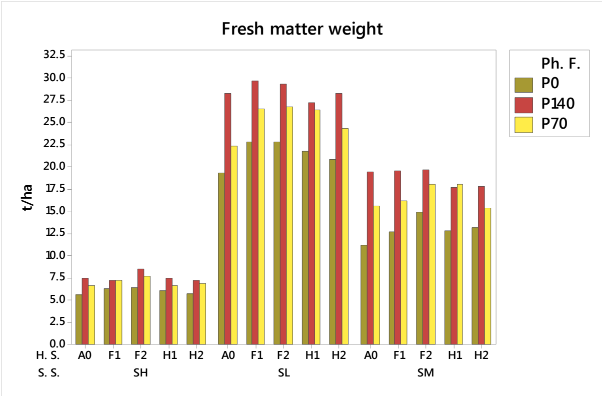

Fig. 2. Effect of the interaction between soil salinity levels (S.S.), humic substances (H. S.) and phosphorus fertilization (Ph. F.) under different soil salinity levels on triticale fresh forage yield.

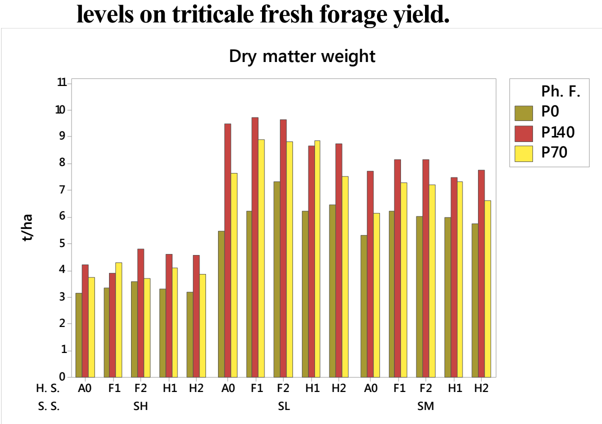

Fig. 3. Effect of the interaction between soil salinity levels (S.S.), humic substances (H. S.) and phosphorus fertilization (Ph. F.) under different soil salinity levels on triticale dry forage yield.

EL-Sayed *et al.* (2014) showed that foliar application of Humic acid at the rate 0.1 % combined with super Bio-phosphate at a rate 104 kg P ha^{-1} had statistically significant effect on fresh and dry weight by radish grown under calcareous soil conditions.

Total nitrogen, Phosphorus and potassium uptake

While, the data in the Tables 4, 5 and 6 indicates that total N, P and K uptake (kg ha^{-1}) of triticale plant were depressed with increased salinity levels during both seasons and in pooled analysis. From previous studies on other crops such as corn the salinity negatively affected the growth and it also decreased the dry weight and the uptake of nutrient elements (Khaled and Fawy, 2011)

Table 4. Effect of humic substances and mineral phosphorus fertilization on total nitrogen uptake (kg ha^{-1}) of triticale under different soil salinity levels.

Treatments	1st				2nd				Pooled analysis			
	Soil Salinity (S. S.)											
	SL	SM	SH	Total	SL	SM	SH	Total	SL	SM	SH	Total
	Humic substances (H. S.)											
A0	76.41	58.69	29.79	54.96	86.26	63.28	30.91	60.15	81.34	60.98	30.35	57.55
H1	87.91	74.79	40.01	67.57	94.57	80.58	41.47	72.21	91.24	77.69	40.74	69.89
H2	82.21	74.05	39.65	65.31	95.70	79.70	41.27	72.22	88.96	76.88	40.46	68.76
F1	103.54	80.87	42.09	75.50	115.83	87.32	43.52	82.22	109.68	84.09	42.81	78.86
F2	116.86	86.68	45.73	83.09	131.57	93.49	47.12	90.73	124.22	90.08	46.42	86.91
Total	93.39	75.02	39.45	69.29	104.79	80.87	40.86	75.51	99.09	77.94	40.16	72.40
LSD 0.05		1.49				0.72				0.87		
	Mineral Phosphor fertilization (Ph. F.)											
P0	67.98	57.15	30.58	51.90	80.48	64.43	33.06	59.32	74.23	60.79	31.82	55.61
P70	97.24	77.33	40.33	71.63	106.74	82.78	40.74	76.75	101.99	80.05	40.53	74.19
P140	114.95	90.57	47.45	84.32	127.13	95.41	48.78	90.44	121.04	92.99	48.11	87.38
Total	93.39	75.02	39.45	69.29	104.79	80.87	40.86	75.51	99.09	77.94	40.16	72.40
LSD 0.05		0.74				0.41				0.47		
H.S. × Ph. F.		**				**				**		

Table 5. Effect of humic substances and mineral phosphorus fertilization on total phosphorus uptake (kg ha^{-1}) of triticale under different soil salinity levels.

Treatments	1st				2nd				Pooled analysis			
	Soil Salinity (S. S.)											
	SL	SM	SH	Total	SL	SM	SH	Total	SL	SM	SH	Total
	Humic substances (H. S.)											
A0	17.73	13.22	7.42	12.79	20.16	15.20	7.86	14.41	18.95	14.21	7.64	13.60
H1	20.79	16.92	9.55	15.75	22.62	17.72	9.55	16.63	21.70	17.32	9.55	16.19
H2	21.02	16.52	8.84	15.46	22.85	18.38	9.31	16.85	21.93	17.45	9.08	16.15
F1	24.85	19.80	10.06	18.24	28.41	21.18	10.33	19.98	26.63	20.49	10.20	19.11
F2	28.66	23.10	11.67	21.14	33.63	25.59	12.35	23.86	31.14	24.34	12.01	22.50
Total	22.61	17.91	9.51	16.68	25.53	19.61	9.88	18.34	24.07	18.76	9.69	17.51
LSD 0.05		0.27				0.44				0.28		
	Mineral Phosphor fertilization (Ph. F.)											
P0	16.34	13.86	7.56	12.58	19.36	16.01	8.02	14.46	17.85	14.93	7.79	13.52
P70	23.68	17.90	9.44	17.01	26.76	19.43	9.89	18.70	25.22	18.67	9.67	17.85
P140	27.81	21.98	11.53	20.44	30.48	23.40	11.73	21.87	29.15	22.69	11.63	21.15
Total	22.61	17.91	9.51	16.68	25.53	19.61	9.88	18.34	24.07	18.76	9.69	17.51
LSD 0.05		0.25				0.24				0.21		
H.S. × Ph. F.		**				**				**		

Table 6. Effect of humic substances and mineral phosphorus fertilization on total potassium uptake (kg ha^{-1}) of triticale under different soil salinity levels.

Treatments	1st				2nd				Pooled analysis			
	Soil Salinity (S. S.)											
	SL	SM	SH	Total	SL	SM	SH	Total	SL	SM	SH	Total
	Humic substances (H. S.)											
A0	86.78	59.23	29.25	58.42	96.15	67.37	31.05	64.85	91.46	63.30	30.15	61.64
H1	104.09	81.18	42.61	75.96	116.60	87.62	44.15	82.79	110.34	84.40	43.38	79.37
H2	107.69	88.16	46.47	80.77	119.98	95.61	46.30	87.30	113.84	91.88	46.38	84.03
F1	140.47	97.96	47.47	95.30	155.46	105.59	49.78	103.61	147.96	101.77	48.63	99.46
F2	153.68	105.42	51.27	103.46	172.59	113.81	52.63	113.01	163.13	109.62	51.95	108.23
Total	118.54	86.39	43.41	82.78	132.15	94.00	44.78	90.31	125.35	90.19	44.10	86.55
LSD 0.05		1.15				0.80				0.57		
	Mineral Phosphor fertilization (Ph. F.)											
P0	85.22	70.97	34.88	63.69	99.61	77.18	37.09	71.29	92.41	74.08	35.98	67.49
P70	121.85	87.85	44.28	84.66	135.32	94.05	44.39	91.25	128.58	90.95	44.33	87.96
P140	148.55	100.35	51.09	100.00	161.54	110.76	52.87	108.39	155.05	105.55	51.98	104.19
Total	118.54	86.39	43.41	82.78	132.15	94.00	44.78	90.31	125.35	90.19	44.10	86.55
LSD 0.05		0.88				0.57				0.61		
H.S. × Ph. F.		**				**				**		

On the contrary, total N, P and K uptake of triticale which were showed in Tables 4,5 and 6 were also, highly significantly ($p<0.01$) increased with Humic substances in all seasons and pooled analysis. A positive result was noticed in triticale nutrients uptake by the use of Humic substances. Indeed, Humic substances have direct and indirect effects on supply and facilitate nutrients to plants. The direct effects are those that require the uptake of Humic substances into the plant tissue resulting in various biochemical outcomes, but the indirect effects involve the improvement of soil properties Tan (2003) and Sangeetha *et al. (*2006). The order of different types of Humic substances for their influences on total N and P uptake were as follows: Falvic soil application > Falvic foliar application > Humic foliar application > Humic soil application > without Humic substances. But, the order of different types of Humic substances for their influences on total K uptake were as follows: Falvic soil application > Falvic foliar application > Humic soil application > Humic foliar application > without Humic substances. The varied effects of different types Humic substances are attributed to the difference of its nutrients contents, its ability to improving soil properties. Al-Jumaily (2016) showed that all application methods of the Humic acid caused in a significant increase in most of parameters used and mix application (land+foliar) have surpass in P-uptake of barley crop.

Also, data in Tables 4, 5 and 6 showed that total N, P and K uptake of triticale were highly significantly ($p<0.01$) increased by mineral phosphorus fertilization in all seasons and pooled analysis. The highest values of triticale growth parameters were obtained with 140 kg P ha^{-1} following by 70 kg P ha^{-1}. Sufficient nutrition of triticale with phosphorus and potassium plays an important role in securing accomplishment of yields close to potential. Both elements fulfill important physiological functions in the plant by taking part in the processes of photosynthesis, transportation of assimilates and protein synthesis (Marschner, 1995). Al-Jumaily (2016) showed phosphorus levels caused a significant increase in all parameters, while the level 20 mg p kg-1 soil achieved highest increase in P uptakeof barley crop.

Data in Tables 4, 5 and 6 shows the effect of interaction between Humic substances and phosphorus fertilization under differrnt soil salnity levels was a high significant ($p<0.01$) on total N, P and K uptake of triticale in both season and pooled analysis. Moreover, the interaction plot of mean of total N, P and K uptake by the interaction between Humic substances and phosphorus fertilization was explaining in Fig. 4, 5 and 6, respectively. Data in Figures 4, 5 and 6 showed that the effect of Falvic soil application (F2) following by Falvic foliar application (F1), and without Humic substances, respectively on Total N, P and K uptake of triticale were the highest with low soil salinity level when use 140 kg P ha^{-1}. But when using 70 kg p ha^{-1} in phosphate fertilization of triticale in low soil salinity (SL), or when using 140 kg p ha^{-1} in phosphate fertilization of triticale in moderate soil salinity (SM), the effect of Humic substances will become clear on total N, P and K uptake of triticale, where all Humic substances treatments (F2 > F1 > H1 > H2 with 70 kg P ha^{-1} under low soil salinity) and (F2 > F1 > H2 > H1 with 140 kg P ha^{-1} under moderate soil salinity) outperformed control treatment.

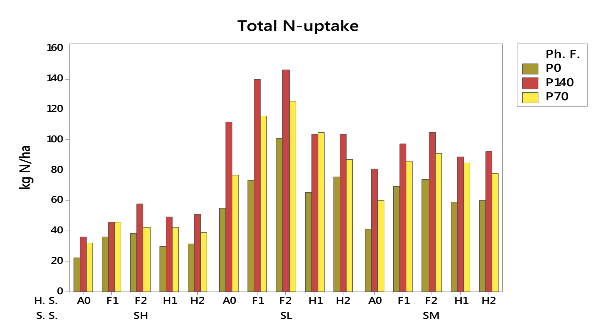

Fig. 4. Effect of the interaction between soil salinity levels (S.S.), humic substances (H. S.) and phosphorus fertilization (Ph. F.) under different soil salinity levels on total N-uptake of triticale.

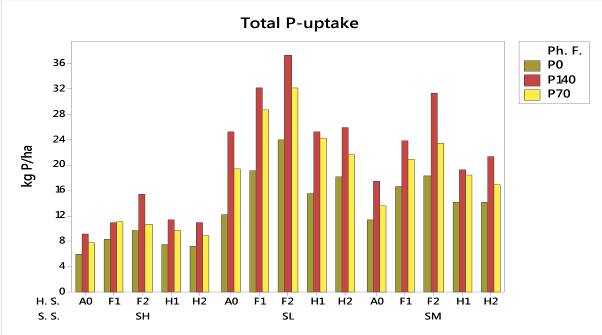

Fig. 5. Effect of the interaction between soil salinity levels (S.S.), humic substances (H. S.) and phosphorus fertilization (Ph. F.) under different soil salinity levels on total P-uptake of triticale.

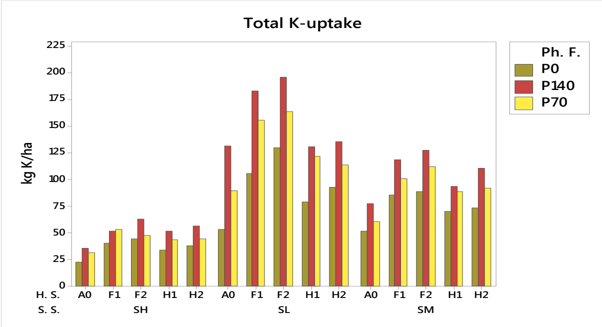

Fig. 6.Effect of the interaction between humic substances (H.S.) and phosphorus fertilization (Ph. F.) under different soil salinity levels (S.S.) on total K-uptake of triticale.

EL-Sayed *et al.* *(*2014) showed that foliar application of Humic acid at the rate 0.1 % combined with super Bio-phosphate at a rate 104 kg P ha^{-1} had statistically significant effect on fresh and dry weight of root and shoot, root length and diameter as well as nutrient content and uptake by radish grown under calcareous soil conditions.

CONCLUSION

The results of our study recommend for improvement of triticale cultivation in saline soil using Humic substances and mineral phosphorus fertilization as mediator to salinity stress. Also, can be recommended when using 70 kg P ha^{-1} in phosphate fertilization of triticale in low soil salinity, or when using 140 kg P ha^{-1} in phosphate fertilization of triticale in moderate soil salinity, the effect of Humic substances will become clear on fresh and dry forage yield and total N, P and K uptake of triticale. Therefore, it is preferred that applying Humic substances and mineral phosphorus fertilization to improvement of triticale production with increasing soil salinity.

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تأثير التفاعل بين المواد الدبالية و التسميد الفوسفورى المعدنى على محصول العلف وامتصاص بعض العناصر الغذائية الكبرى للتريتيكال تحت مستويات مختلفة من ملوحة التربة.

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الملوحة تصبح واحدة من أكثر المشاكل الزراعية أهمية وخطورة. علاوة على ذلك ، فإنها تشكل تهديداً دائمًا لإنتاجية المحاصيل، خاصة في البلدان التي يعتبر فيها الرى من العوامل المحددة للنشاط الزراعى. من المعروف أن ملائمة المحاصيل هي إحدى الطرق للتغلب على مشكلة ملوحة التربة ، مثل نبات التريتكال الذي يتميز بأنه محصول مناسب للنمو في التربة المالحة. أجريت تجربتان حقليتان لدراسة تأثير التفاعل بين مستويات ملوحة التربة والمواد الدبالية وتسميد الفسفور المعدني، وذلك لتطوير زراعة الترتيكال في الأراضى المالحة وذلك من خلال دراسة التأثير على ارتفاع النبات ، محصول العلف الطازج والجاف ، الإمتصاص الكلى للنيتروجين والفوسفور والبوتاسيوم في العلف الجاف. أوضحت النتائج أن جميع مدلولات الدراسة قلت مع زيادة مستويات الملوحة. في حين أن ترتيب المواد الدبالية من حيث التأثير على معايير النمو للتريتكال الإمتصاص الكلى للنيتروجين والفوسفور والبوتاسيوم كانت على النحو التالي: المعاملة الأرضية للفالفيك > فالفيك رش> هيوميك أرضى> هيوميك رش> بدون مواد دبالية (كنترول). من ناحية أخرى ، استخدام 140 كجم فوسفور / هكتار أعطت أعلى النتائج لجميع القياسات السابقة ثم استخدام 70 كجم فوسفور / هكتار. بينما يظهر تأثير التفاعل الثلاثي أنه عند استخدام 70 كجم فوسفور / هكتار من التسميد الفوسفاتى للتريتكال المزروع في تربة ذات الملوحة المنخفضة، أو عند استخدام 140 كجم فوسفور / هكتار من التسميد الفوسفاتى للتريتكال المزروع في تربة ذات الملوحة المعتدلة، سيصبح تأثير المواد الدبالية واضحًا على محصول العلف الطازج والجاف وإجمالي امتصاص النيتروجين والفوسفور والبوتاسيوم. لذلك ، من المفضل أن يتم استخدام المواد الدبالية والتسميد الفوسفوري المعدني لتحسين إنتاج التريتيكال مع زيادة ملوحة التربة.