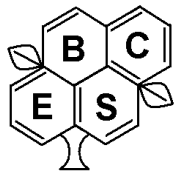

Journal

RESPONSE OF WHEAT TO SOIL AND FOLIAR APPLICATIONS WITH PHOSPHORUS AND POTASSIUM FERTILIZERS IN CLAY LOAM SOIL

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ABSTRACT

Tow field experiments were carried out at El-Gemmiza Farm Agricultural Research Station, Agricultural Research Center Egypt , in two successive winter seasons of 2016 / 2017 and 2017 / 2018 to compare the effect of soil and foliar application of phosphorus and potassium fertilizers on soil fertility and the productivity of wheat (*Triticum aestivum* .L) plants . Split plot design with three replicates was used. The main plots were soil application of phosphorus and potassium in rates of 50%, 75%, 100% P_2O_5 and K_2O of recommended doses compare to control (without any soil application zero of p and K). While the sub main plots were foliar application of K– solution (0.2 %K_2O) and p – solution (0.45% P_2O_5) and its combinations. The results revealed that , Soil application phosphorus and potassium significantly increased the grain yield, straw yield and their concentration of N , p, K % , grain protein and total carbohydrate percentage. The addition of K and p foliar generally had enhancing effect on wheat productivity and improved its concentration N, p , K and total chlorophyll .The highest value were recorded by K + p –solution foliar followed by its spray at p – solution foliar. the addition of both 100% K and P soil application and K - solution foliar gave the highest increments of the grain , straw , biological yield and protein as well as 100% K and P soil application and K + P –

solution foliar gave the highest values of N, P, K, total chlorophyll and plant height but p- solution foliar with 100% K and P soil application gave the heights values of 1000 grain weight.
Key words : foliar,Phosphorus, Potassium, soil application, wheat.

INTRODUCTION

Phosphorus (P) is an important nutrient for plant growth and crop productivity **(Daly *et al.*, 2015)** It's the second essential plant nutrient after nitrogen for plant growth. **Noonari *et al.*, (2016)** demonstrated that 80-90% of P applied to soil either are lost into the environment or become unavailable for plants. While the farmers stay using the recommended dose of phosphorus fertilizer, the P is usually fixed very quickly resulting in low P use efficiency **Archana *et al.*, (2016)**. The deficiency of P in soil is mainly due to strong interactions with inorganic and organic soil components. Potassium (K) is the third major nutrient for most plants after nitrogen and phosphrus in the fertilization process. Among the minerals, potassium and nitrogen (N) are required in larger quantities than other micro and macro elements . **Bagyalakshmia *et al.*, (2017)** despite ere searches on potassium got less attention than nitrogen and phosphorus which led to nominate the potassium the "forgotten nutrient**" Lu *et al.*, (2017)** Plants require K for several important plant physiological process such as the activation of various enzymes, the synthesis and metabolism of carbohydrates, protein synthesis, and the opening and closing of stomata thus controlling gas exchange and photosynthesis (**El-Sharkawy *et al.*, 2017).** Potassium fertilizer applied conventionally to the soil mostly gets fixed with clay minerals and turns to be unavailable for crop plants **(Ali *et al.*, 2005).** Wheat is the most important cereal food crops in the world. In Egypt, its production doesn't meet the current demand **(Abdrabbo *et al.*, 2016). FAO, (2015)** reported that, Egypt is the most populous country in the Arab World, is also by far the largest importer of wheat globally. Wheat production is affected by different factors such as irrigation, climatic conditions, planting time, while fertilization is important key in wheat production **(Ehdaie *et al.*, 2001; Shaaban, 2006 and Abdrabbo *et al.*, 2016).** Foliar application has become a very useful practice to remediate the nutritional deficiencies in plants caused by traditional supply of nutrients to roots **(Ling and Silberbush, 2002).** Recently,

application of phosphorus and potassium as foliar application are particularly useful under Egyptian soil conditions where, it suffers greatly from alkalinity, therefore, most elements fixed and become unavailable for plant uptake (**Abdel-Motagally, 2014). Tantawy *et al*., (2010)** reported that, the combination of foliar application of phosphorus with potassium enhanced squash plant height, number of leaves, fresh and dry weight of shoots and total weight of fruits. **EL-Dissoky., (2013)** showed that, application of NPK fertilizer at 50% of the recommended as soil application + 1%N + 1%P +1%K foliar (f3) recorded the highest grains yield .Also **Gul *et al*., (2011)** reported that, growth performance of wheat was highly influenced by the foliar application of two times of 0.5%N , 0.5%K. and 0.5%Zn solutions at tailoring and booting stages. **Ali *et al*., (2016)** showed that Foliar spray of potassium 3% K_2O concentration was more efficient for increasing growth and yield of maize crop compared to soil application and fertilization of potassium fertilizer.

Thus, the aim of this study was to compare the effect of soil and foliar application of phosphorus and potassium fertilizers on soil properties and the productivity of wheat plants.

MATERIALS AND METHODS

Two field experiments were conducted in El-Gemmiza farm, Agricultural Research Station, Agricultural Research Center, Egypt, (C 30 43 latitude and 31 longitude) during two winter seasons 2016/2017 and 2017/2018 to study the effect of different rates of soil application and foliar application of phosphorus and potassium fertilizers on soil fertility and the productivity of wheat (*Triticum aestivum* L) plants (CV. Gemmiza 9). The experiment laid out in split plot design with three replicates in clay loam soil.

Table (1) represent some physical and chemical characteristics of the soil according to the standard methods according to **Black *et al*., (1965) and Jackson, (1967).**

Table (1) some physical and chemical properties of the experimental soil.

Particle size distribution (%)			Texture	pH (1:2.5)	EC ($dS.m^{-1}$)	O.M (%)	$CaCO_3$ (%)	Available nutrients ($mg.Kg^{-1}$)		
Clay	Silt	Sand	Clay loam	7.89	2.11	2.00	1.85	N	P	K
40.0	44.7	15.3						17.9	7.0	370

The treatments were assigned as the follows:

Main plots:

1. Control (without soil application of Potassium and phosphorous fertilizers)
2. P and K fertilization (50%) of Recommended dose
3. P and K fertilization (75%) of Recommended dose
4. P and K fertilization (100% Recommended dose P and K)

Sub-main plots:

1. K –solution 0.2 % K_2O.
2. P – solution 0.45% p_2O_5 .
3. K-solution 0.2% K_2O+P– solution 0.45% p_2O_5 .

The soil application treatments of Phosphorous and Potassium (100% -75 % and 50 %) were applied according to extension guide for wheat, ministry of agriculture, Egypt (**Negm, 2009**).The phosphorus applied as mono-super phosphate (15.5% P_2O_5) during soil preparation with the rate of 6.54, 4.91 and, 3.27 Kg p Fed^{-1}, and potassium applied as potassium sulfate (48% K_2O) at rate of 19.92, 15and 10 Kg $K.Fed^{-1}$ with the second irrigation. The mineral nitrogen fertilizer (urea 46% N) at the recommended rate was applied into two equal doses at first and second irrigations .

The foliar solution (potassium and phosphorous) was 200 $LFed^{-1}$ and twice spraying were added the first at time of tilliring stage (about 30 days after sowing) and the second foliar after 15 days of the first foliar application. The plot area was 10.5 m^2 and the planting date was 5th December of both seasons 2016 and 2017. Fresh samples were taken at 75 days after sowing to determine total chlorophyll according to **Moran**, **(1982)**. Shoot samples after 75 days and after harvesting were dried in oven at 70° C and stored till analysis. Plant biomass properties via grain yield, straw yield and 1000 grain weight were investigated. Samples of grains from each treatment were oven dried at 70° C then milled using pistol and grinding and kept for chemical

analysis 0.2 gm of dried shoots and grains were digested with 5 mL of concentrated H_2SO_4 and 1 ML of 80% perchloric acid. Digested materials diluted to 100 mL to analyzes of total N, P and K. Micro-Kjeldahl method was used for total nitrogen according to **Jackson, (1967),** potassium was determined using flame photometer **Page (1982).** While phosphorus was analyzed calorimetrically according to **Schouwenbury and waling**, **(1967).** Crude protein in grains was calculated by multiplying grains contents of N % by 5.7 as referred by **A.O.A.C (2000).** Total hydrolysable carbohydrates in both shoots and grains were determined according to **Thomes and dutcher (1924).**

All data were statistically analyzed using analyst of variance technique by means of **M. STAT – C** computer program according to **Snedecor and Cochran, (1980).**

RESULTS AND DISCUSSION

Effect of soil and foliar application with potassium and phosphorous fertilizer levels as well as their interaction on wheat plants biomass.

Data in **Table (2)** showed the effect of soil potassium and phosphorous fertilizer levels on wheat yield. The present results demonstrate that application of potassium and phosphorous increased 1000-grain weight, grain, straw and biological yield compared to control treatment This may be attributed that, increasing potassium Fertilizer levels significantly increase number of tillers/plant , spike length , number of grains / spike , grain weight /spike and 1000 grain weight **(Hussein, 2005)** .Concerning the effect of spraying wheat plants with potassium and phosphorous, data in **Table (2)** indicated that, increased 1000-grain weight, grain yield, straw yield, biological yield and plant height with treated wheat plants. The foliar application always improves yield even if the soil poor in nutrients **(Girma *et al*., 2006)**. **Samad *et al* ., (2014)** prescribed that, foliar sprays of nutrient solution at tillirng , jointing and boot stages along with half of the recommended dose of N and P to increase yield and yield components of wheat. **Rawashdeh and sala, (2016)** proved that, foliar fertilization of wheat affects significant increase both grain and straw yield. From data in **Table (2),** show the effect of soil and foliar application with potassium and phosphorous fertilization as well as their interactions on 1000-grain weight, grain yield, straw yield,

biological yield and plant height of wheat plants. The results indicate that grain yield, straw yield, and biological yield showed significantly effect, on the other hand 1000-grain weight and plant height showed non significant response. Grain yield, straw yield and biological yield recorded the highest values from 75% (K+P) soil application treatment, grain 4.13, 6.39, and 9.95 (ton / fed),respectively This results with harmony with those obtained by **EL-Dissoky., (2013)** . Also, data in **Table (2)** show the effect of foliar application with K,P and (K+P) on wheat plants. The results indicate that all parameters under study were significant (at 5% L.S.D) however, the plant height was no significant. The data in **Table (2)** showed that spray application with P gave the higher values than K- spray treatments for 1000-grain weight, grain yield, straw yield, and biological yield. However, foliar application of K+P the highest values of 1000-grain weight, straw yield and biological yield. That gave 41.27g,6.63 and 10(ton/ fed),respectively, comparing with other treatments .Also, **Table (2)** shows the interaction between soil and foliar application with potassium and phosphorous fertilizers on 1000-grain weight, grain yield, straw yield, biological yield and plants height on wheat plants. The results indicated that values of 1000-grain weight, straw yield, and biological yield showed a significant effect (LS.D at 5%). However, grain yield and plant height showed no significant effect. 1000-grain weight recorded the highest value from fertilizer wheat plants with 100% potassium + phosphorous and spray grain yield the highest value From 100(%) potassium +phosphorous Fertilizer and spray potassium application gave 2.61 (ton/Fed) compared zero Fertilizer and spray potassium Straw yield recorded the highest value from 75(%) potassium + phosphorous Fertilizer and spray phosphorous application gave 3.64 (ton/Fed) compared to zero Fertilizer and spray phosphorous application. Biological yield showed the highest value from 50(%) Fertilizer Potassium + phosphorous and spray potassium + phosphorous application gave 6.778 (ton/fed) compared zero Fertilizer and spray potassium alone and phosphorous alone.

Minerals content percentage (N,P,K) in grains and straw as well as shoots were recorded in Table(3and4),data showed that application of potassium and phosphorous Fertilizer levels significantly increased minerals content percentage compared to control , this may be duo to

that potassium fertilizer increased nutrients uptake. **Abdull-Ahil *et al*.,(2006).**

Table (2): Effect of soil and foliar application with potassium and phosphorous fertilizer levels as well as their interaction on 1000-grain weight, grain yield, straw yield, Biological yield and plant height on wheat plants.

Parameter Treatments		1000-Grain weight (gm)	Grain yield (ton/fed)	Straw yield (ton/fed)	Biological yield (ton/fed)	Plant height (cm)
Soil fertilizer levels: *A*						
Control		40.867	2.629	4.283	6.924	105.089
50(%)		40.00	3.687	6.11	10.019	105.856
75(%)		39.911	4.130	6.391	10.499	101.626
100(%)		40.956	4.010	6.161	9.948	104.144
L.S.D at 0.05		N.S	0.636	0.703	0.813	N.S
Foliar fertilizer: *B*						
K		39.908	3.628	5.161	8.963	103.986
P		40.125	3.663	5.421	9.084	103.658
K+P		41.267	3.551	6.628	9.995	109.892
L.S.D at 0.05		1.530	0.546	0.702	1.719	N.S
c- interaction fertilizer levels:						
Zero	K	41.033	2.415	3.79	6.305	104.033
	P	40.70	2.613	3.692	6.305	105.133
	K+P	40.867	2.860	5.367	8.160	106.10
50	K	39.339	2.80	4.098	7.565	103.133
	P	39.367	4.90	4.508	9.408	108.767
	K+P	41.30	3.36	9.724	13.083	105.667
75	K	38.70	4.27	5.81	10.013	104.843
	P	42.20	4.13	7.336	11.466	101.733
	K+P	38.833	3.99	6.028	10.018	98.30
100	K	40.567	5.026	6.944	11.97	103.933
	P	42.80	3.01	6.146	9.156	103.933
	K+P	39.50	3.995	5.392	8.719	104.567
L.S.D at 0.05		3.447	N.S	1.0597	1.228	N.S

Minerals content percentage significantly increased in grains and shoots are showed in **Table (3 and 4)** with spraying wheat plants with potassium and phosphorus. Minerals content in grains and shoots showed non significantly effect in grains minerals content percentage

Table (3), recorded the highest value from 100(%) potassium + phosphorous

Fertilization and spray potassium + phosphorous compared to zero fertilization. Nitrogen in shoots (75 days after sowing) recorded the highest value from treated wheat plants with 100(%) potassium +phosphorous fertilizer and spray potassium + phosphorous application, on the other hand the lowest value from zero Fertilization and spray phosphorous application.

Table(3): Effect of soil and foliar application with potassium and phosphorous fertilizer levels as well as their interaction on mineral content percentage, crude protein content and Total hydrolysable carbohydrate T.H.C percentage

(as glucosegm/100gm sample) of grains and straw of wheat plants.

Parameter treatments		Grains					Straw		
		N (%)	P (%)	K (%)	Crude protein content	T.H.C %	N (%)	P (%)	K (%)
A Soil fertilizer levels:									
Control		1.480	0.257	0.314	10.456	62.255	0.242	0.129	0.506
50(%)		2.002	0.270	0.338	11.339	65.634	0.405	0.132	0.533
75(%)		2.144	0.294	0.358	11.953	67.456	0.502	0.137	0.565
100(%)		2.144	0.307	0.393	12.753	68.998	0.714	0.142	0.592
L.S.Dat 0.05		0.450	0.0227	0.0141	0.24	7.084	0.1483	0.001	0.009
B- Foliar fertilizer levels:									
K		1.956	0.273	0.347	10.929	65.749	0.359	0.133	0.542
P		1.987	0.279	0.324	11.437	65.846	0.460	0.135	0.528
K+P		2.154	0.295	0.381	12.561	66.662	0.579	0.137	0.576
L.S.D at 0.05		N.S	0.014	0.022	1.765	N.S	0.0706	0.0015	0.0348
c- interaction fertilizer:									
Zero	K	1.881	0.248	0.319	9.942	64.417	0.181	0.127	0.503
	P	1.638	0.251	0.294	9.942	63.828	0.212	0.129	0.493
	K+P	2.002	0.273	0.33	11.512	68.918	0.334	0.131	0.520
50	K	1.82	0.264	0.334	9.948	64.417	0.364	0.132	0.525
	P	2.063	0.269	0.311	11.86	64.517	0.374	0.134	0.515
	K+P	2.123	0.279	0.368	12.209	67.965	0.457	0.134	0.558
75	K	2.063	0.281	0.353	10.756	65.699	0.364	0.138	0.553
	P	2.123	0.299	0.339	11.738	67.521	0.506	0.139	0.559
	K+P	2.245	0.303	0.382	13.365	69.147	0.637	0.139	0.582
100	K	2.063	0.298	0.383	13.07	68.457	0.526	0.141	0.588
	P	2.123	0.298	0.351	12.209	67.518	0.728	0.145	0.544
	K+P	2.245	0.362	0.444	12.98	71.018	0.890	0.148	0.642
L.S.D at 0.05		N.S	N.S	N.S	N.S	N.S	0.107	N.S	N.S

Chemical characteristics in wheat plants after harvesting

Data concerning the effect of different levels potassium and phosphorous fertilizer on crude protein of wheat grains are shown in **Table (3).** The present results show that, increasing levels of fertilizer significantly increased crude protein percentage of grains, increasing potassium and phosphorous fertilizer level from control to 100% potassium and phosphorous resulted in increasing crude protein content by 2.28 proteins content. This may be explained due to the role of potassium, increasing the concentration of messenger ribonucleic acids in plant cell –messenger ribonucleic acids is essential for many biochemical processes within cells. Activation of several biochemical processes results in an increase in protein content, **Hussein, (2005)**. Data concerning in **Table (3)** spraying potassium and phosphorous significantly increased crude protein content in grains. It is obvious from the data in **Table (3),** crude protein content in grains showed

non significantly effect, crude protein recorded the highest value from treated wheat plant with75 (%) potassium + phosphorous fertilizer potassium +phosphorous application gave 3.423(%) compared the lowest value from zero potassium + phosphorous and spray potassium alone and phosphorous alone. The combination between foliar and soil fertilization with P and K increased grain contents of N , P , K and protein and our results in agreement with **Gomaa *et al*., (2015).**

Chemical characteristics in wheat plants after 75 days of planting:

Data presented in **Table (4)** illustrate that both chlorophyll a and b as well as total chlorophyll increased With application of (100% potassium + phosphorous) compared to the control plants , total chlorophyll found to be increased by 1.516 (**mg/dm^2**) with increasing fertilization potassium and phosphorous to100(%) compared to untreated plants. The increment in chlorophyll content by raising potassium rate may be due to the role of potassium element in, stimulating biological processes in the plant cell **(Hussein, 2005).** It is obvious from the data in **Table (4)** all sprayed treatments potassium and phosphorous) significantly increased chl .a, chl.b and total chlorophyll at 75 days after sowing. The combination between foliar and soil fertilization with P and K enhanced wheat plants. With regard to the interaction effect between soil fertilizer and foliar potassium

and phosphorous, **Table (4)** revealed that treated wheat plants with 100% potassium + phosphorous fertilizer levels in soil and sprayed wheat plants with potassium + phosphorous concentrations recorded the highest value of chl .a , chl . b , total chlorophyll (at 75 days after sowing) with average value of 1.614, 0.718, 2.348 mg/dm^2 respectively compared with treated wheat plants with zero potassium and phosphorous fertilizer levels application in soil and foliar phosphorous application.Total hydrolysable carbohydrates (T.H.C) in grains and shoots are recorded in **Table (3 and 4)** Data showed that highest level of (potassium and phosphorous 100%) Fertilizer gave the highest T.H.C percentage, while the control plants gave the lowest T.H.C percentage. Generally, increasing potassium Fertilizer level increased the T.H.C percentage of wheat plants. May be due to the role of potassium element in stimulates biological processes in the plant cell as photosynthesis and creation of carbohydrate as reported by **Hussein (2005).** Total hydrolysable carbohydrates in grains and shoots are presented in **Table (3 and 4),** Data demonstrated that, the highest T.H.C percentage from wheat plants treated with potassium in shoots, on the other hand in grains with potassium + phosphorous. Total carbohydrates in grains and shoots were mentioned in **Table (3 and 4)** total carbohydrates in grain showed non significantly effect, the highest value in grain recorded with100% potassium + phosphorous application in soil and spraying potassium + phosphorous concentrations 7.19% compared to zero fertilizer and spray phosphorous on the other hand total carbohydrate percentage in shoots (75 days after sowing) showed significant effect and recorded the highest value with100% potassium and phosphorous fertilizer levels and foliar spray potassium + phosphorous application on wheat plants

Table (4): Effect of soil and foliar application with potassium and phosphorous fertilizer levels as well as their interaction on chl.a ,chl.b , chl a+b (mg/dm^2), Total hydrolysable carbohydrate (T.H.C) percentage (as glucose gm/100 gm sample) and minerals content percentage (N, P, K) of wheat plants (at 75 days after sowing) .

Parameter Treatments		Chl.a mg/dm^2	Chl.b mg/dm^2	Chl.a+b mg/dm^2	(T.H.C) %	N (%)	P (%)	K (%)
A- Soil fertilizer levels:								
Control		3.431	1.135	4.566	27.147	2.17	0.225	1.969
50%		3.643	1.341	4.984	29.294	2.225	0.234	2.269
75 %		4.081	1.536	5.617	29.531	2.445	0.251	2.581
100 %		4.516	1.561	6.082	30.949	2.619	0.254	2.751
L.S.D at 0.05		0.197	0.157	0.3101	N.S	0.225	0.0208	0.429
B- Foliar fertilizer:								
K		3.797	1.351	5.149	29.36	2.282	0.235	2.41
P		3.733	1.265	4.997	29.031	2.336	0.239	2.213
K+p		4.223	1.563	5.791	29.294	2.475	0.249	2.554
L.S.D at 0.05		0.081	0.084	0.137	N.S	0.213	0.0077	0.257
c- interaction fertilizer levels:								
Zero	K	3.35	1.068	4.418	31.177	2.123	0.222	2.08
	P	3.333	0.999	4.332	30.684	2.061	0.223	1.587
	K+P	3.61	1.337	4.947	26.733	2.324	0.230	2.24
50	K	3.573	1.283	4.857	26.89	2.142	0.228	2.257
	P	3.440	1.183	4.623	26.378	2.307	0.234	2.150
	K+P	3.917	1.1557	5.473	28.171	2.226	0.242	2.40
75	K	3.953	1.493	5.447	28.821	2.407	0.247	2.547
	P	3.87	1.470	5.340	28.801	2.427	0.250	2.50
	K+P	4.42	1.643	6.063	30.259	2.499	0.257	2.697
100	K	4.313	1.560	5.873	30.574	2.457	0.243	2.737
	P	4.287	1.470	5.693	30.261	2.548	0.251	2.617
	K+P	4.947	1.717	6.680	32.013	2.851	0.266	2.880
L.S.D at0.05		0.122	N.S	N.S	4.177	N.S	N.S	N.S

Effect of soil and foliar application of P and K fertilization on soil fertility :

There were no significant differences between fertilization practices on soil fertility **Figure (1)** represented that the interaction between recommended levels (100%) of P and K as soil application combined with foliar application resulted in increasing the soil available N and K recording 28.8 and 825.4 $mg.kg^{1}$ respectively, while using 0.2% K_2O as foliar fertilizers with 50% soil phosphorus and potassium fertilization recorded the highest available P in soil after wheat harvesting. It is clearly evidence that basal application of recommended dose of nitrogen will result in increasing soil N after harvesting, and that is in agreement with **Kumar, (2015)** who explained that, the nitrogen applied to the soil been a part of available nitrogen in soil after harvesting of wheat plants. **Gosavi *et al.*, (2017)** detected that, application of recommended dose of fertilizers significantly increased soil N and K. The interaction between 75% P and K in soil application with 0 .45%P_2O_5 foliar application resulted in decreasing soil N and P than control recording 18.67 and 31.32 $mg.kg^{-1}$, while using 0.2% K_2O in foliar fertilization with 75% soil phosphorus and potassium fertilization recorded the lowest available K in soil after wheat harvesting recording 517.49 $mg.kg^{-1}$.

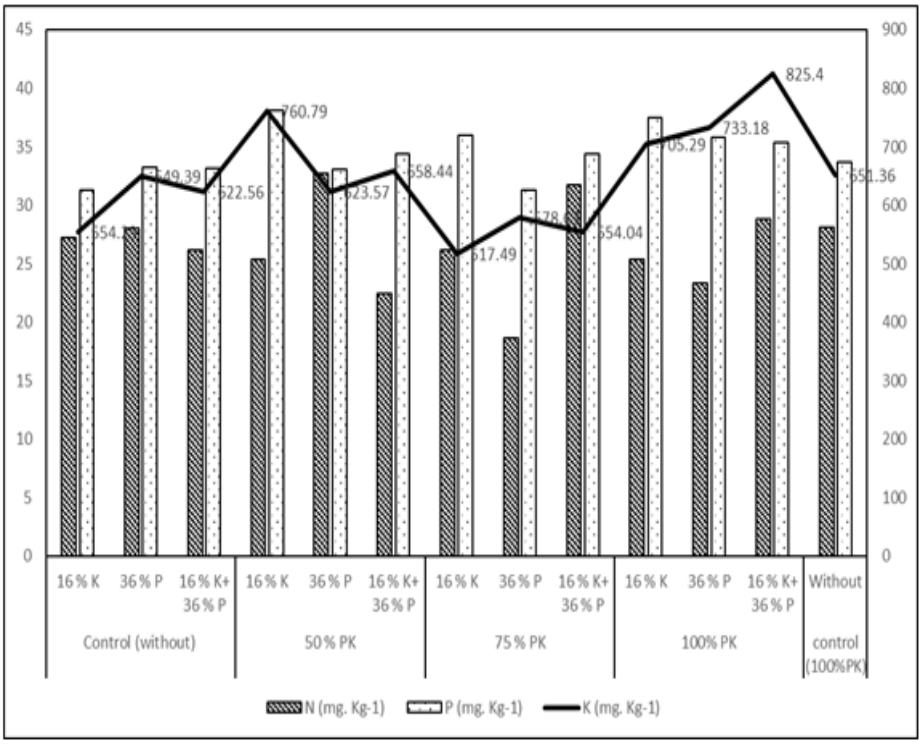

Figure (1) Effect of soil and foliar application with potassium (K) and phosphorus (P) fertilizers on soil fertilty of soil after harvesting wheat plants

Conclusion

It could be concluded that, foliar application is not enough to increase the productivity of plants. The interaction between soil and foliar application of different fertilizer had a significant effect in enhancing wheat plants productivity. The obtained results revealed that, 50% basal fertilization in combination with foliar application of P- solution (0.45% p_2o_5 Gave the highest plant yield .While, 100% basal fertilization in combination with foliar application of K- solution ($0.2\%K_2O^{)}$ gave the highest grain, straw and biological yield .as well as 100% basal fertilization in combination with foliar application of K- solution + p – solution gave the highest chemical components in both straw and grains and highest available P and K concentration in soil – spraying with P and K with soil Fertilization enhanced plant biomass and soil fertility.

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استجابة القمح للتسميد الأرضى والورقى بالفوسفور والبوتاسيوم فى الأراضى اللوميه الطينية

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أجريت تجربتان زراعيتان خلال الموسم الشتوى للعام 2017/2016 و2018/2017 بمحطة البحوث الزراعية بالجميزة - مصر – وذلك لمقارنة تأثير اضافة الفوسفور والبوتاسيوم للأراضى مع الاضافة رشا على المجموع الخضرى على انتاجية محصول القمح ويسر بعض العناصر الغذائية فى الأراضى الطينية . تم استخدام القطع المنشقة مرة واحده ، القطع الرئيسية الاضافة الأرضية للفوسفور والبوتاسيوم بمستويات 50% و 75% و 100% بالمقارنة بالكنترول (بدون اضافة تسميد أرضى من الفوسفور والبوتاسيوم) أما القطع تحت الرئيسية كانت الرش الورقى لمحلول البوتاسيوم (0.2 %) ومحلول الفوسفور (0.45 %) وخليط من الفوسفور والبوتاسيوم بمعدل لتر/ فدان وذلك فى ثلاث مكررات . وأوضحت النتائج :-

1- أدت الاضافة الأرضية للفوسفور والبوتاسيوم الى زيادة محصول الحبوب والقش وزيادة محتواها من النتروجين والفوسفور والبوتاسيوم وأيضا زيادة محتوى الحبوب من البروتين والكربوهيدرات الكلية.

2- اضافة البوتاسيوم والفوسفور رشا يحسن من انتاجية القمح ومحتواه من النتروجين والفوسفور والبوتاسيوم والكلورفيل الكلى و كانت أعلى قيم تم الحصول عليها من الرش بمخلوط الفوسفور والبوتاسيوم يليه الرش بالفوسفور بمعدل 1لتر/ فدان .

3- اضافة 100% من التسميد الأرضى بالفوسفور والبوتاسيوم مع الرش بمحلول البوتاسيوم أعطى أعلى محصول حبوب ومحصول قش والمحصول البيولوجى وبروتين الحبوب أيضا 100% من التسميد الأرضى بالفوسفور والبوتاسيوم مع الرش بمخلوط من محلول الفوسفور والبوتاسيوم أعطى أعلى القيم من النتروجين والفوسفور والبوتاسيوم والكلورفيل الكلى وطول النبات الرش بمحلول الفوسفور مع 100% من التسميد الأرضى للفوسفور والبوتاسيوم فقد أعطت أعلى وزن لل 1000 حبة .