

## Effect of Some Phosphorus Fertilizer Packages on Growth and Yield of Some Egyptian Wheat Varieties

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### Abstract

Two pot experiments and field experiment were carried out at Agric. Res. Station, Fac. Agric., Al-Azhar Univ. Nasr City and El-Aleg region, Kaliobia governorate, Egypt, during 2011/2012, 2012/2013 and 2013/2014 to investigate the influence of phosphorus fertilizer packages as bio fertilizer on the productivity of wheat varieties. The three studied phosphorus fertilizer packages treatments were phosphorene, humic acid 6%, phosphorene+ humic 6% acid and control (without P) as well as three wheat varieties (Sakha-93, Masry-1 and Banisweif). Complete randomized design was applied for the pot experiments, whereas, split plot design was conducted for the experimental field. Results showed significant differences between the three tested wheat varieties Masr-1 variety exceeded sakha-93 and Baniswif-6 in grain yield characters. Moreover, Baniswif-6 gave grains quality characters higher than Sakha-93 and Masr-1 varieties in cache season under pot and field experiments, as for phosphorus treatments, results indicated that, there were significant differences between the various phosphorus fertilizer packages treatments in both seasons under pot and field experiments. P4 and P3 treatments recorded the highest values of growth, yield, and yield components as compared with P1 treatment in the three seasons in pot or field experiments. The interaction effect between (var. X P. packages) showed that most of the studied characters were significant by the interaction between the two studied factors.

**Keywords:** Phosphorene; Wheat; Biofertilizers; Varieties; Packages; Yield

### Introduction

In Egypt, wheat is considered as one of the main and strategic crop that caused a complicated problem especially the high gap between production and consumption, the local production equal 40% whereas the importing equals 60% roughly from our requirements. Many researches and attempts were carried out to overcome this problem in the recent years by the application of nitrogen biological fertilizer beside the mineral one to reduce the cost, the additive amount of mineral fertilizer and environmental pollution [1], demonstrated that, humic substances improve soil fertility modifying the physical, chemical and biological conditions in soil. Zientara [2] confirmed that humic acid could increase uptake of certain elements and stimulate the dry matter production of shoots. Besides, the stimulation of ions uptake by treatment with humic materials, it could be proposed that these materials effect to membrane permeability. Chang [3] recorded that an increase in soil organic matter by the application of manure, solubility of P increased in the soil solution due to increase in microbial activity and mycorrhizal growth in the soil. Ayob [4] found that treating wheat plants with organic fertilizer or humic acid gave the maximum biomass weight at heading stage. The increase in shoot and root emergence is due to sufficient supply and release NPK. Adami [5] published that humic substances improve soil fertility by modifying the physical, chemical and biological conditions in soil, added to that they show positive effect on plant biomass. Abd El-Ghany [6] studied the effect of different sources of phosphate on wheat plants grown in soil that contains a small amount of available phosphor. The results indicated that inoculated wheat grains with soluble phosphate bacteria enhanced available phosphorus concentrations around the roots. Increasing phosphorus levels increased plant height, dry weight/plant, grain and straw yield. Hassanein [7] evaluated the response of three wheat cultivars (Sakha-69, sids-7 and sids-8) to varying phosphorus levels (0, 15.5 and 31 kg P/fed.) and biofertilization with phosphate dissolving bacterium (*Bacillus megaterium*), *Azotobacter beijerincki* and *Candida*

tropicalis. The highest values for plant height, No. of tillers and spikes, as well as weight of spikes/plant, also grain and straw yield/fed. Khalil [8] discussed the effect of manure fertilizer combined with bio fertilizer (*Azospirillum brasilense* and *Bacillus inegotherium phosphaticum*) on wheat growth grown on sandy and clay soils. The results revealed that, manure fertilizer in the combination with P bio fertilizer led to significant increase in wheat dry weight. Sher [9] discussed the impact of organic fertilizer (625 kg h<sup>-1</sup>), organic fertilizer+HA at 10 kg ha<sup>-1</sup> as well as the control treatment in wheat growth yield and it's components. The results showed that, wheat crop morphological and agronomical parameters were increased significantly as subjected the plants to the application of organic fertilizer+HA at 10 kg ha<sup>-1</sup>, as compared with the other studied treatments the target of this research it to investigate the effect of phosphorus fertilizer packages as bio fertilizer on growth and yield as well as yield components of three wheat varieties (Sakha-93, Masry-1 and Baniswif-6) that were obtained from wheat Res. Inst. Agric. Res. Center, Giza, Egypt.

### Materials and Methods

Two pot experiments were conducted during 2011/2012 and 2012/2013 in Agric. Res. Station, Fac. Agric. Al-Azhar Univ. Nasr City, Cairo and one field experiment was carried out in El-Aleg region, Kaliobia governorate, Egypt, to study some application affecting the availability of the huge amount of phosphorus fixed the Egyptian on growth and yield as well as yield components of three wheat varieties

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(Sakha-93, Masry-1 and Baniswif-6) that were obtained from wheat Res. Inst. Agric. Res. Center, Giza, Egypt. The experiment treatment as follow:

### The pot experiment

**The studied treatments:** A. Wheat cultivars: Sakha-93, Masry-1, Baniswif-6.

B. Application affecting the availability of phosphorus: Control (untreated) P1, Adding 100% phosphorene (bio- fertilizer) P2

At the rate of 8 envelopes/fed, the weight of each on 500 g in two equal portions as follow:

□ the first at sowing by mix it by the seed,

□ The second was added before the first irrigation before planting by mix the content of the envelopes by amount of the soil and broadcast it gast before irrigation.

1. Adding 100% Humic acid (organic fertilizer) 6 % at the rate of 40 L/fed as foliar application in 200 L/fed. P3

2. Adding 100% phosphorene (at the previous rate and methodology)+100% humic acid as foliar application at the previous rate. P4

These studied treatments were arrangement in complete randomized design with three replicates where the number of pots was 36. The pot or the experimental unit was a plastic pouch, its high equals 52 cm, it is circumference equals 78 cm and the surface area of pot equals 0.1074 cm. Each one contained 75 g from composed that was added as general organic fertilizer beside the different weights from the studied treatments. Whereas phosphorene as bio-fertilizer were mixed with wheat grains at the rate of 0.5 g before sowing. Super phosphate was added at the rate of 1.87 g for each pot according to the recommended dose (150 kg/fed.) whereas potassium sulphete was applied at the rate of 0.51 g for each one according to the recommended dose (50 kg/fed.). Each pot contained 5 plants according to the optimum rate for the number of grains equals 90 plant/m<sup>2</sup>. Irrigation was applied according to the determination of field capacity where the pots irrigate every 15 day until saturation. To avoid the losing of any amount of the additive fertilizer with irrigation water, plastic plates were put under every pot for saving the homogeneous between the experimental units due to the amount of water and the distribution of the different fertilizers. Organic composted was applied to the all-experimental units at the rate of 75 g/ pot, it equals 6 ton/fed. Table 1 cleared the chemical analysis of that used composed.

The sowing date was on the 20 of November in 2011/2012 and on the 22 of November in 2012/2013 season. The chemical and mechanical analysis for the experimental soil for both season were tabulated in Table 2.

### The field experiment

**The studied treatments:** They were similar to those obtained in the pot experiments.

The split plot design with three replications was used in this experiment, whereas the tested wheat varieties were allocated in the main pots. The area of each plot was 56 m<sup>2</sup> (16 × 3.5) and the four studied treatments of each experiment were devoted in the sub plots 14 m<sup>2</sup> (3.5 × 4 m) for each. The recommended dose of nitrogen (75 kg N/fed) and the half one (37.5 kg N/fed) were added as Ammonium Nitrate 33.5%. Phosphorus fertilizer was applied at the rate of 150 kg/fed. (15.5% P<sub>2</sub>O<sub>5</sub>), while Potassium one was experimented at the rate of 50 kgk/fed. (48.8% K<sub>2</sub>O), they were applied before sowing. Table 2

shows the mechanical and chemical properties of the experimental soil. Sowing date was on the 28 of November in 2013/2014 season.

The studied characteristics: A. Growth character:- In both experiments five plants were chosen randomly to estimate - Plant height, in cm, it was calculated after booting stage.

- Flag leaf area, in cm<sup>2</sup>, it was estimated after flowering stage.

B. Yield and yield components:-At harvesting time the same plants were harvested to determine - No. of grains/spike.

- 1000-grain weight (g).

- Grain yields per plant and per feddan.

- Harvest indes.

Determination	The pot experiments during		The field experiments during
	2011/2012	2012/2013	2013/2014
PH	7.8	7.7	7.6
O.M	38.11	38.33	36.45
EC (dsm <sup>-1</sup> )	0.47	0.46	0.51
C/N	14.8	14.72	15.28
N%	1.48	1.51	1.43
P%	0.55	0.56	0.54
K%	0.45	0.45	0.46
Fe(ppm)	1.25	1.28	1.27
Cu(ppm)	1.58	1.62	1.59
Zn(ppm)	1.82	188	1.91
Mn(ppm)	1.12	1.15	1.21

**Table 1:** Chemical analysis of the applied compost during the three growing seasons.

Soil analysis	The pot experiments during		The field experiments during
	2011/2012	2012/2013	2013/2014
A-Physical analysis:			
Particle size distribution:			
Sand%	77.65	76.9	72.7
Clay%	10.35	10.8	14.1
Silt%	12	12.3	13.2
B-Chemical analysis:			
Catins(mg/L)			
Na <sup>++</sup>	2.6	2.4	1.88
Mg <sup>++</sup>	1.3	1.2	1
Ca <sup>++</sup>	1.5	1.4	2
Anins(mg/L).			
CL <sup>-</sup>	1.91	1.88	1.5
SO4 <sup>-</sup>	2.6	2.71	2.23
HCO3 <sup>-</sup>	1.8	1.82	1.6
CO3 <sup>-</sup>	0	0	0
pH	7.4	7.3	8.2
EC(dsm <sup>-1</sup> )	0.72	0.78	0.4
Cu+(ppm)	0.6	0.52	0.48
Zn <sup>++</sup>	0.65	0.72	0.92
Mn <sup>++</sup>	4.2	4.3	6
Fe <sup>++</sup>	1.87	1.92	1.1
Available N(ppm)	15	15	15
Available P(ppm)	137	135	140
Available K(ppm)	728	720	604
Texture	Sandy loam	Sandy loam	Sandy loam

**Table 2:** Some physical and chemical analysis of the experimental sites during the three growing seasons.

## Statistical analysis

The complete randomized design with three replications for the pot experiments and the split plot design with three replications for the field experiment, as well as factorial arrangement were used. The obtained results subjected to statically analysis according to procedure outlined by Sneadecor [10]. Means were compared using the least significant differences (LSD) test at 5% level of probability.

## Results and Discussion

### Plant height (cm)

Data in Table 3 explicated that the difference between the studied wheat varieties due to and flag leaf area (cm<sup>2</sup>) was significant. In pot and field experiments, the results revealed that plant height of Sakha-93 wheat varieties were 72.52, 72.68 and 75.93 cm that surpassed Masr-1 and Banisweif-6 varieties due to plant height during the three experimental seasons. In this respect Sakha-93 wheat variety plant height were 6.99, 6.88 and 4.54% higher than Banisweif-6 wheat variety during the three experimental season respectively. This might be due to as expected to the higher uptake of Sakha-93 for nutrients as well as higher rate of moisture absorption and greater use of light than Banisweif-6 these results may be due to the difference in number and/or length of internodes reflecting the genetical makeup of the plant. These findings are in similar trend with those of Hassanein [7], and Sharaan [11].

Regarding to phosphorus fertilizer packages, results during 2011/2012, 2012/2013 and 2013/2014 seasons revealed that the application of treatment phosphorene bacteria+humic acid (P4) gave the tallest wheat plant height 73.81, 73.92 and 77.54 cm respectively, as compared to the most other phosphorus packages. However, P1 treatment (without added P fertilizer) recorded the shortest plants 66.10, 66.68 and 68.95 cm under the pot and the field experiment during the three seasons, respectively. P4 treatment surpassed significantly P1 treatment by 11.66, 10.86 and 12.46% as well as by 6.78, 7.02 and 5.56% than P2 during the three experimental seasons respectively. It worthy to mentioned that P3 and P4 did not reach to the significant level, during the three seasons, similar results were reported by Abd El-Ghany, Khalil, El-kholy and Shahryari [6,8,12,13].

The interaction effect between wheat varieties × P fertilizer packages on wheat showed significant effect on wheat plant height during the two seasons of the pot experiment as well as in the field one; this showed that each of these two factors under study acted independently on this trait.

### Flag leaf area (cm<sup>2</sup>)

Data presented in Table 4 detect that significant variation differences among the three tested wheat varieties, where, Sakha-93 wheat variety possessed the highest with mean values of 65.86, 66.14 and 64.63 cm<sup>2</sup>, during 2011/2012, 2012/2013 and 2013/2014 seasons respectively. Consequently, Banisweif-6 recorded the lowest estimates 63.55, 62.69 and 57.36 cm<sup>2</sup> for flag leaf area trait during the three seasons respectively. The superiority ratios between Sakha-93 and Banisweif-6 were 3.63, 5.50 and 12.67% in the three seasons, respectively. These results may be due to that the three varieties differed in its ability to capture the growth factors water, nutrient and light Zeidan [14] and Abd El-Maksoud [15] reported similar results.

Regarding to phosphorus fertilizer packages, results of the three experiment during 2011/2012, 2012/2013 and 2013/2014 seasons revealed that the application of phosphorene bacteria+Humic acid (P4) resulted flag leaf area significantly higher than P1 treatment (without added P), with the mean values of 68.63, 66.64 and 66.30 cm<sup>2</sup> during

2011/2012 and 2012/2013 and 2013/2014 seasons respectively. On the other hand, P1 treatment (without added P) recorded the lowest estimates for flag leaf area in the three experimental seasons (60.81, 61.62 and 56.36 cm<sup>2</sup>). The increments between the highest values between P4 treatment and P1 treatment were 12.86, 8.15 and 17.64 % for the pervious trait in the first, second and third seasons respectively.

The interaction effect between wheat varieties × P fertilizer packages showed significant effect on flag leaf area during the two seasons of the pot experiment as well as the field experiment. As for flag leaf area, cultivating Sakha-93 wheat variety and fed its plants by P4 treatment produced the highest values of flag leaf area in the three experiments, they were 69.81, 69.07 and 69.53 cm<sup>2</sup>, respectively. While the lowest values of this trait were recorded for Banisweif-6 when treated its plants with P1 treatment 59.43, 60.34 and 52.99 cm<sup>2</sup> in pot and field experiments respectively.

### Number of grains/spikes

As for the variance between the tested wheat varieties Table 5 the results revealed that Masr-1 wheat variety surpassed the other tested wheat varieties (Sakha-93 and Banisweif-6) due to number of grains/spike 44.43, 42.57 and 42.95 in the three seasons respectively. Without significant differences between Masr-1 and Sakha-93 in 2012/2013 season. Masr-1 wheat variety surpassed significantly Banisweif-6 wheat variety by 7.68, 7.99 and 19.87% for number of grains/spike that may reflect the variation in the genetically makeup of the studied wheat varieties. In addition, this result might be due to as expected to the higher uptake of Masr-1, variety for nutrients, higher rate of moisture absorption and greater use of light as Sakha-93. These results are in accordance with those of Sharaan [11], and Abd El-Maksoud [15].

Regarding to phosphorus fertilizer packages, results of the three experiment during 2011/2012, 2012/2013 and 2013/2014 seasons revealed that the application of phosphorene bacteria+humic acid (P4) gave the highest number of grains/spike 44.65, 43.89 and 41.58 respectively without significant differences between P4 and P3 in first and second seasons. It is interesting to note that the application of phosphorene bacteria with humic acid (P4) was more effective P1 treatment by 12.30, 14.78 and 9.33% for the previous trait during 2011/2012, 2012/2013 and 2013/2014 seasons respectively, Abd El-Ghany, Khalil, Beringer and El-kholy [6,8,12,16] reported these findings.

As for the interaction effect, results revealed that, it had significant effect on number of grains/spike, cultivating Masr-1, wheat variety and fertilized its plants with Phosphorene bacteria+Humic acid (P4) gave the highest number of grains/spike in the three experiments 47.71, 45.09 and 44.16 in the three session, respectively. While the lowest number of grains/spike were recorded for Banisweif-6 without added P (P1 treatment).

### 1000-grain weight (g)

With regard 1000 grain weight in gram Table 6 showed that Masr-1 Variety ranked the first (49.64, 49.84 and 40.52) during the three experimental seasons under pot and field experiments, without significant differences between Masr-1 and Sakha-93 for this trait in 2011/2012 season (pot experiment). On the other hand, Banisweif-6 recorded the lowest 1000-grain weight 40.58, 41.00 and 33.34 during the three experimental seasons, respectively. Masr-1 wheat variety surpassed significantly Banisweif-6 by 22.33, 21.56 and 21.54% for 1000-grain weight trait during the three tested seasons. Similar results were found by Hassanein [7] as for 1000-grain weight trait, data recorded in Table 7 cleared that the increment between P4 treatments over P1

**Table 3:** Effect of phosphorene, humic acid and phosphorien+humic acid on plant height (cm) of the three wheat varieties in 2011/2012, 2012/2013 and 2013/2014 seasons.

Character	plant height(cm)														
	2011/2012(pot exp.)					2012/2013(pot exp.)					2013/2014(field exp.)				
Season	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean
p.fert.packg															
Varieties															
Sakha-93	67.41	71.28	75.2	76.17	72.52	68.8	71.05	74.95	75.9	72.68	70.45	75.12	78.66	79.5	75.93
Masr-1	67.02	69.93	73.76	74.15	71.21	66.98	69.85	73.42	74.63	71.22	68.99	73.13	76.01	77.12	73.81
Banisweif-6	63.86	66.15	70.01	71.11	67.78	64.26	66.31	70.21	71.23	68	67.41	72.12	75.01	76	72.63
Mean	66.1	69.12	72.99	73.81	70.5	66.68	69.07	72.86	73.92	70.63	68.95	73.45	76.56	77.54	74.13
LSD at 5% Varieties(V)		1.57					1.87					2.86			
P.fertilizer(P)		1.81					2.16					1.69			
VXP		NS					NS					NS			

**Table 4:** Effect of phosphorene, humic acid and phosphorene + humic acid on Flag leaf area (cm<sup>2</sup>) of the three wheat varieties in 2011/2012, 2012/2013 and 2013/2014 seasons.

Character	Flag leaf area (cm <sup>2</sup> )														
	2011/2012(pot exp.)					2012/2013(pot exp.)					2013/2014(field exp)				
season	p1	p2	p3	p4	Mean	p1	p2	p3	p4	Mean	p1	p2	p3	p4	Mean
N.fert.packg															
Varieties															
Sakha-93	60.63	64.32	68.67	69.81	65.86	61.88	64.61	68.98	69.09	66.14	59	62.01	67.98	69.53	64.63
Masr-1	62.37	64.02	68.08	68.86	65.83	62.63	63.31	66.03	66.15	64.53	57.1	61.85	67.04	68.12	63.53
Bani swif-6	59.43	61.52	66.02	67.23	63.55	60.34	61.41	64.35	64.67	62.69	52.99	55.09	60.13	61.24	57.36
Mean	60.81	63.29	67.59	68.63	65.08	61.62	63.11	66.45	66.64	64.45	56.36	59.65	65.05	66.3	61.84
LSD at 5% Varieties(V)		0.74					0.73					1.59			
P.fertilizer(P)		0.85					0.64					0.74			
VXP		1.48					1.27					1.29			

**Table 5:** Effect of phosphorene, humic acid and phosphorene + humic acid on Number of grains/spikes of the three wheat varieties in 2011/2012, 2012/2013 and 2013/2014 seasons.

Character	No. of grains/spike														
	2011/2012(pot exp.)					2012/2013(pot exp.)					2013/2014(field exp.)				
Season	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean
p.fert.packg															
Varieties															
Sakha-93	40.26	41.18	43.71	44.01	42.29	39.70	40.90	44.26	44.52	42.34	38.94	41.53	43.01	43.33	41.71
Masr-1	39.01	43.99	47.02	47.71	44.43	39.12	41.20	44.87	45.09	42.57	41.80	42.80	43.05	44.16	42.95
Banisweif-6	40.01	40.78	42.01	42.23	41.26	35.90	37.77	41.96	42.07	39.42	33.36	35.98	36.75	37.25	35.83
Mean	39.76	41.98	44.25	44.65	42.66	38.24	39.96	43.70	43.89	41.45	38.03	40.10	40.94	41.58	40.16
LSD at 5% Varieties(V)		0.51					0.57					1.11			
P.fertilizer(P)		0.59					0.65					0.61			
VXP		1.02					1.13					1.06			

**Table 6:** Effect of phosphorene, humic acid and phosphorene + humic acid on 1000-grain weight (g) of the three wheat varieties in 2011/2012, 2012/2013 and 2013/2014 seasons.

Character	1000-grain weight (g)														
	2011/2012(pot exp.)					2012/2013(pot exp.)					2013/2014(field exp.)				
Season															
p.fert.packg	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean
Verities															
Sakha-93	47.87	46.90	50.43	51.00	49.05	37.90	46.30	51.77	53.10	47.27	35.10	37.51	42.00	43.02	39.41
Masr-1	46.40	48.87	51.20	52.10	49.64	45.47	49.10	52.00	52.80	49.84	36.01	38.13	43.82	44.11	40.52
Banisweif-6	38.00	39.00	42.10	43.20	40.58	37.70	38.60	43.20	44.50	41.00	29.54	32.10	35.47	36.24	33.34
Mean	44.09	44.92	47.91	48.77	46.42	40.36	44.67	48.99	50.13	46.04	33.55	35.91	40.43	41.12	37.75
LSD at 5% Varieties(V) P.fertilizer(P) VXP		0.54					0.65								
		0.62					0.75					0.48			
		1.07					1.29					0.70			
P fertilizer package.		P1= control o phosphorus					P2=Phosphorene bacteria					1.06			
		P3= humic acid					P4=Phosphorene bacteria + humic acid								

treatment were 10.61, 24.21 and 22.56% compared by P1 for 1000-grain weight during the three seasons respectively. These results could be attributed to the important role of phosphorus nutrient in enhancing and improving the naturally existing nutrient transformation activities in the soil profiles.

The interaction between the factors under testing showed significant effect on that trait during the three experiments seasons, results in Table 7 clear that treating plants of Masr-1 variety by Phosphorene bacteria + Humic acid(P4) gave the heaviest grains during the three experiments the all seasons, 52.10, 53.10 and 44.11 g respectively, Khalil, El-kholy and Mohamed [8,12,17] reported similar results.

### Grain yields per plant and per fadden

As for the variance between the tested wheat varieties, Table 7, the results revealed that Masr-1 wheat variety surpassed the Sakha-93 and Banisweif-6 varieties in respect with grain yield/plant (9.26, 10.91 g) and 2.43 ton/fed during the three experimental seasons, without significant difference between Masr-1 and Sakha93 in 2011/2012 season Masr-1 exceeded Banisweif-6 by 10.76, 10.83 and 25.44 for the previous trait during the three experimental seasons, respectively. The differences in grain yield/plant or fed. Between the three-tested wheat, varieties (Sakha-93, Masr-1 and Banisweif-6) attributed to the diversities in photosynthetic capacity of the wheat plants during the different stages and development. These findings are in accordance with those obtained by Zeidan and Nagwa [14,18].

Regarding to, phosphorus fertilizer packages, the results of the experiments during 2011/2012, 2012/2013 and 2013/2014 revealed that the application of Phosphorene bacteria + Humic acid (P4) recorded the highest values of grain yield/ plant (10.11, 10.15 g) and 2.51 ton/fed. During the previous seasons, as compared to the other P packages, without significant differences between P3 and P4 in this trait. It is clear that Phosphorene bacteria + Humic acid (P4) yielded out P1 treatment (without added phosphorus) by 38.87, 38.66 and 32.72%, during the three experimental seasons. It worthy to mentioned that the differences

between P3 and P4 did not reach to the significant level. The increase in grains yields is attributed to the important role of P nutrient in enhancing and improving the naturally existing nutrient transformation activities in the soil profiles. These results are in accordance with those obtained by Mohamed and Inamullah [17,19].

The interaction between wheat varieties × P fertilizer packages showed significant effect on grain yield during three seasons, As for grain yield, cultivating Masr-1 wheat variety and fertilized its plants with Phosphorene + Humic acid (P4) gave the highest mean values of grain yield/plant in the pot experiment (10.87 and 10.91 g/plant) also in the field experiment (2.71 Ardab/fed), while the lowest mean values of this trait was recorded for Sakha-93 variety with P1 treatment (7.21 and 7.25 g/plant) in pot experiment and (2.01 ton/fed) in field experiment.

### Harvest index trait

Results in Table 8 show that Banisweif-6 wheat variety gave the highest values of harvest index trait under the condition of the pot experiment during 2011/2012 and 2012/2013 seasons (36.86 and 37.02%), without significant differences between it and Masr-1 in this respect. However, under the field experiment, Masr-1 revealed the highest values of harvest index trait (37.25) and surpasses Sakha-93 and Banisweif-6 in this trait but without significant differences between Sakha-93 and Banisweif-6 in this respect. It could be concluded that the varietal differences between the tested wheat varieties may be due to the genetically differences them, and the differences in their response to the environmental conditions.

As for harvest index, results in Table 8 reveal that the application of Phosphorene bacteria+Humic acid (P4) the highest gave values of this trait in three experiments during the three seasons, without significant differences between P4 and P3 treatment. In the same time, the differences between P2 and P1 treatments did not reach the significant level.

Data recorded in Table 8 clear that the significantly of harvest

**Table 7:** Effect of phosphorene, humic acid and phosphorene + humic acid on Grain yields per plant and per Fadden of the three wheat varieties in 2011/2012, 2012/2013 and 2013/2014 seasons.

Character	Grain yield														
	2011/2012(pot exp. g/plant)					2012/2013(pot exp. g/plant)					2013/2014(field exp. ton/fed)				
Season	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean
p.fert. package															
Varieties															
Sakha-93	7.21	8.58	9.94	10.22	8.98	7.25	8.60	9.96	10.27	9.02	2.01	2.21	2.48	2.55	2.31
Masr-1	7.51	8.68	9.99	10.87	9.26	7.55	8.71	10.05	10.91	9.31	2.08	2.33	2.60	2.72	2.43
Banisweif-6	7.12	8.07	9.01	9.23	8.36	7.15	8.10	9.09	9.26	8.40	1.58	1.79	2.14	2.25	1.94
Mean	7.28	8.44	9.65	10.11	8.87	7.32	8.47	9.70	10.15	8.91	1.89	2.11	2.41	2.51	2.23
LSD at 5% Varieties(V) P.fertilizer(P)		0.58					0.24					0.07			
VXP		0.66					0.28					0.05			
		1.15					0.48					0.08			

**Table 8:** Effect of phosphorene, humic acid and phosphorene + humic acid on harvest index of the three wheat varieties in 2011/2012, 2012/2013 and 2013/2014 seasons.

Character	Harvest index														
	2011/2012(pot exp.)					2012/2013(pot exp.)					2013/2014(field exp.)				
Season	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean	P1	P2	P3	P4	Mean
p.fert. packg															
Varieties															
Sakha-93	34.48	34.90	36.88	37.22	35.87	34.53	40.90	36.88	37.32	35.91	35.24	35.33	36.39	36.69	35.91
Masr-1	34.70	36.03	36.99	38.59	36.58	34.79	41.20	37.13	38.63	36.65	35.52	36.53	37.98	38.96	37.25
Banisweif-6	35.16	36.55	37.68	38.07	36.86	35.32	37.77	37.92	38.19	37.02	33.58	33.22	36.06	37.80	35.17
Mean	34.78	35.83	37.18	37.96	36.44	34.88	39.96	37.31	38.04	36.53	34.78	35.03	36.81	37.82	36.11
LSD at 5% Varieties(V) P.fertilizer(P)		0.95					0.90					1.53			
VXP		1.10					1.04					1.11			
		NS					NS					NS			

index was increased under the condition of applying P4 treatment by 9.14, 9.06 and 8.74% under the pot and field experiments during 2011/2012, 2012/2013 and 2013/2014 seasons. These results could be explained on the light the favorable effect of phosphorus as a nutrient transformation activities in the soil profiles, as well as the vital role of phosphorus bacterial inoculation reflected positive effect in such trait according to the favorable effect of these bacteria, which helped wheat plants to produce higher yield components with the best quality of grain and straw also the important role of humic acid in biosynthesis in plant. The interaction effect between the two studied factor did not reach the 5% level of significance during 2011/2014 season. Moreover, the insignificant showed that each of these two factors acted independently on this trait.

## Conclusion

Significant gain in wheat plant parameters i.e. flag leaf area (cm<sup>2</sup>) No. of grains/spike, 1000-grain weight (g), and grain yield/plant and Fadden had been detected by the interaction between the studied varieties and phosphorus bio fertilizer. Interaction during the field experiment. In

most studied traits Masr-1 or Sakha-93 awarded the highest values as subjected the plant to fertilize with humic acid only (P3) or humic acid with phosphorene bacteria (P4) The superiority of these wheat varieties as compared with the others may be ought to their high efficiency towards photo synthesis process and more uptake of water and minerals from soil, this reflected on increasing the production of more sizeable organs such as grains No. of spikes and 1000-grain weight, added to the significant difference between the studied varieties may be due to the genetically difference and their response to phosphorus bio fertilizer. Practical Applications: Applying 50% of recommended mineral P fertilizers with bio fertilizers (phosphorene bacteria + humic acid) are suitable fertilization treatment for maximizing the productivity of wheat varieties Sakha-93, Masr-1 and Baniswif-6 in pot or field experiments.

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