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Bio fertilizer doses and foliar application of amino mix to enhance the performance of pea plant under newly reclaimed land conditions

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ABSTRACT

Two testing trails were finished through winter season of 2015/2016 and 2016/2017 at the experimental station of the National Research Centre at Nubaria region, (North Egypt) to project the emulation of pea plants to foliar application of different levels of amino acid (Amino mix) at 4 cm/L, 8 cm/ L and foliar spraying with water together with pollination by N-fixers bacteria (Netropein) at 1kg/fed, it was placed at once or they were placed on two batches and without N-fixers bacteria and interaction effect for leverage plant growth, total pods yield and its components as well as seeds nutrition value of pea plants c.v. Little Marvel. These treatments were position in split plot styling seek with three replications. The brief results obtained from this field that: 1-Foliar application by high concentration of amino mix (8 cm/L) significantly improved the most plant growth characters, total yield and its components as well as the seeds contents of the percentage of N, protein, P and K followed in descending order by that plants spraying by 4 cm/L followed with foliar spraying with water. 2-Inoculated pea plants by two batches of N-fixing bacteria (Netropein) at (1 kg/fed.) significantly override inoculated by once dose and without inoculated (control) in plant length, number of leaves/plant, fresh and dry weight of plant and number of pods/plant, total yield (ton/fed.) and weight of 100- seeds as well as the content of N %, protein %, P % and K% in seeds tissues. 3-The interaction among the doses of bio-fertilizer and foliar application of amino mix generated no significant variance.

Key words: pea plants**,** N-fixing, amino mix levels, growth, yield.

Introduction

Bio fertilizer utilize become a substantial component in an inserted nutrient nutrition system and hold a great promise to improve crop yields through better nutrient supplies. *Azotobacter,* is the most important bacteria to the non-symbiotic fixation of atmospheric N. Bio fertilizer plays a vital role in restoring the natural soil nutrient cycle by fixing and released plant available N forms to soil (Mahdi *et al*., 2010), as well as stimulating plant growth through the synthesis of growth promoting substances (Frankenberger and Arshad, 1995; Noel *et al*., 1996). Among the explanations proposed for plant growth promotion by these bacteria is an increased uptake of mineral nutrients (Bashan and Levanony, 1990). Using bio fertilizer in improving the plant growth, yield, and quality of bean plants have reviewed by several authors (El- Bassiony *et al.,* 2010). Inoculation of bio-fertilizers is important to substitute of chemical fertilizers for healthy and cheap production. It is are formulations of beneficial microorganisms, which upon application can increase the availability of nutrients by their biological activity and help to improve the soil health and increase soil fertility by increasing the number of such microorganisms and accelerate certain microbial processes Pandya and Saraf (2010). Bio-fertilization is generally based on altering the rhizosphere flora, by seed or soil inoculation with certain organisms (microbial inoculants), capable of inducing beneficial effects on a compatible host El-Haddad *et al* (1993). These bacteria utilize atmospheric nitrogen gas for their cell protein synthesis. This cell protein is then mineralized in soil after the death of the Azotobacter cells thereby contributing towards the nitrogen availability of the crop plants thus resulting in a strong symbiotic relationship Haller and Stople (1985). However, the results of Sarhan (2008) indicated a positive effect of Azotobacter on growth and yield of potato plants. There is some micro-organism which stimulates the Azotobacter population in soil thereby increasing the nitrogen fixation by Azotobacter.

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However, Shehata *et al* (2006) results showed that the maximum increments of vine length and leaf number as well as fresh and dry weight of shoots were recorded by the inoculation of seeds with Azotobacter. Biogein and Netropein produced the intermediate values. In the same respect Sarhan *et al* (2011) results revealed that Azotobacter alone significant effects on vegetative (shoot) parameters, and substantially improved the quantitative and qualitative traits of fruit yield of summer squash plants including plant height (cm), number of branches plant, number of leaves plant, fresh weight of the plants, dry weight of the plants, and total chlorophyll also on yield characteristics such as number of fruits plant, fruit length (cm), fruit diameter (cm), percent of TSS, early yield (kg plant) and total yield (ton \fed.). Moreover, Aisha *et al* (2013) on spinach and Shafeek *et al* (2014) on pea found that inoculation of high rate of bio fertilizer piogen (2 kg/fed.) resulted significant increase in most growth characters, i.e. number of leaves/plant, fresh and dry weight of whole plant, leaf area/plant and total chlorophyll contents as well as total yield of leaves (ton/fed.). Also gave the highest percentage of protein, N, P, K and No_3 content. However, Shafeek, *et al* (2016) on broad bean plant found that inoculated broad bean seeds by highest level of N-fixing bacteria (piogen) (2 kg/fed.) significantly exceed vaccinated by low level (1 kg/fed.) and without inoculated (control) in plant length, number of shoots and leaves/plant, fresh and dry weight of plant and pod characters (length and wide), number of pods/plant, total yield (ton/fed.) and weight of 100- seeds as well as the content of N %, protein %, P % and K% in seeds tissues.

In connection with suitable effects of foliar spraying amino acids, many researchers have found that, the useful effects of amino acids to increase growth and yield for all crops. It is the essential ingredients for the operation of protein synthesis and exceedingly uses for the biosynthesis of pigments, vitamins, coenzymes, purine and pyrimidine bases (Kamar and Omar 1987). The demand of amino acids in essential quantities is well known as a mean to increase yield and total quality of crops. The application of amino acids for foliar spray is established on their requirement by plants in general and critical stages of growth in special. Also amino acids are basis ingredients in the process of protein synthesis. About 20 important amino acids are implicated in the process of each function (Awad, *et al.,* 2007). Some researchers pointed out the importance of amino acids in increasing growth, yield and chemical composition of some economic plants. However, El- Shabas *et al.* (2005) spraying garlic plants with a mixture of glycine, alanine, cysteine and arginine (each at 100 ppm) or with 100 ppm of cysteine alone gave significant increases of total yield over the control by (13.96 % and 13.66 %) and (14.40 % and 16.65 %) in the first and second seasons, respectively. Amino acids are implicated in the synthesis of other organic compounds, such as protein, amines, alkaloids, vitamins, enzymes, terpenoids (Ibrahim *et al.,* 2010). Amino acids are conclusive to stimulating cell growth, act as buffers, provide a source of carbon and energy and protect the cells from ammonia toxicity, with amid formation (Abdel Aziz *et al.,* 2010). The application of amino acids can stimulate the performance of plant (Abdel-Mawgoud *et al.,* 2011). Amino acids have a chelating effect on micronutrients. Commercially available amino acid stimulants can improve fertilizer assimilation, increase uptake of nutrients and water, enhance the photosynthetic rate and dry matter divide, and hence increase crop yield. Many studies have been demonstrate that amino acids can directly or indirectly effect the physiological activities in plant growth and development. In addition, foliar application of amino acids caused an enhancement in plant growth, fruit yield and its components (El-Shabasi *et al.,*2005) on garlic (Awad *et al.,* 2007) on potato, (Faten *et al* 2010) on squash and (Shafeek *et al* 2012) on onion. In the same respect, Ghaith and Galal (2014) reported that, spraying pea plants with mixture of amino acid at 100 ppm significantly increased plant growth characters, total pods yield and pods quality. In addition, Shafeek *et al* (2016) on garlic reported that the biggest bulb yield as tons/fed. and better physical possession of bulb (fresh and dry weight), acquired when amino mix spatter 3 times at high level (2 %). Also, the acquired conclusion recorded the highest nutritional amount of garlic bulb tissues were recorded with splash of amino mix at the higher concentration. Also, Shafeek, *et al* (2016) on broad bean plant found that foliar application by high concentration of amino mix (2%) significantly improved the most plant growth characters, total yield and its components as well as the seeds contents of the percentage of N, protein, P and K followed in descending order by that plants spraying by 1 % followed with the control treatment.

Materials and Methods

This study was carried out at the experimental station of the National Research Centre, Beheira Governorate (north of Egypt), during the two winter season of 2016 and 2017 to investigate the effect of inoculation with N-fixers bacteria (Netropien) it was placed at once or they were placed on two batches and without N-fixers bacteria with foliar application of different level of amino acid (Amino- mix) for influence plant growth, total yield and its components as well as nutrition value of seeds in pea plants c.v. Little Marvel. Netropien produced by Ministry of Agriculture. The chemical constituents of Amino-mix were shown in Table (1).

Table 1: The chemical composition of amino acid (Amino- mix).

Elements (g/100cm3)	Value	Amino acid	Value	Amino acid	Value	Vitamin (mg/100cm3)	Value
Zn	2	Aspartic	249	Methionine	180	B1	0.8
Fe	1.5	Thiamine	45	Isolicine	52	B2	2.4
Mn	0.5	Serine	56	Therionine	38	B6	1.2
Mg	0.004	Glotamic	55	Lalamine	22	B12	0.82
Cu	0.004	Glisiny	50	Histidine	12	Folic	4.2
Ca	0.025	Alanin	100	Liocine	40	Pantothemic	0.52
Br	0.056	Praline	38	Argentine	20	Niacein	0.14
S	0.01	Valine	68	Treptofane	20	Ascorbic	1.0
Co	0.03	Cystin	44	-	-	-	-

The experimental trails were conducted in sandy soil using drip irrigation system. Chemical analysis and physical properties of experimental soil are shown in Table (2).

Table (2): physical and chemical soil shown in table (2):

Table 2: Physical properties and chemical analysis of the experimental soil

Physical properties							
Sand		Clay	Silt	Texture	F.C.%	W.P. %	
90.08		9.26	0.66	Sandy	16.57	5.25	
Chemical analysis							
E.c. M/m	pH	Meq/ L					
		Ca	Mg	Na	K	HCO3	Cl
1.7	8.2	7.02	0.527	0.982	0.31	1.3	0.566

Every experiment included 9 treatments which were the combinations between doses of N-fixers bacteria (Netropien) at rate of (1 kg/fed) cash all in one or two doses plus control treatment without bio-fertilizer with foliar spray of two levels of amino acid (Amino-mix) at rate (4 cm/L and 8 cm/L) plus control treatment (foliar spraying with water). Pea seeds were sown on 20 and 22 of October in 2016 and 2017 seasons respectively. The experimental design was split plot with 3 replications, where the bio fertilizer treatments were assigned in the main plots and amino acid treatments were devoted within the subplots. The experimental plot area was 10.5 m^2 and included 5 rows (each was 3.5 m length and 60 cm width) and the distance between plants was 10 cm. The normal cultural practices i.e. irrigation; fertilizer and pest control for the pea productions were followed and the first batch of bio fertilizer before planting and the second batch three weeks later. However, foliar spraying of amino-mix was achieved after 20 days from sowing date, every 10 day's intervals for three times. Plant samples were taken 60 days after sowing where five plants were chosen from each sub plot and the following data were recorded: plant length (cm), number of leaves per plant, fresh and dry weight of leaves as g/ plant. Yield of each sub plot was weighed and expressed as tons per feddan and for the some physical properties of pea pods samples of 20 pods were taken from each experimental plot number of pods/ plant, number of seeds/pod and 100 seeds weight (g) were recorded. At the same time, chemical analysis i.e. the percentage of N, P and k contents in dry seeds were determined according to the methods of Pregl (1945), Troug and Mayers (1939) and Brown and Lilleland (1964) respectively. But the percentage of crude protein was determined according to A. O.A.C. (1975). All

obtained data were subjected to the statistical analysis and means were compared according to LSD at 5% level test described by Gomez and Gomez (1984).

Results and Discussion

A- Growth characters:

Effect of bio fertilization doses:

The results clarify in Table (3) for the effect of the calculated doses of bio-fertilizer treatments on pea plant growth characters i.e., plant height (cm), number of leaves, fresh and dry weight of leaves. However, placed on two batches by bio-fertilizer significantly increased all plant growth characters of pea plants compared placed at once and control treatment. These conclusions were true in both seasons of study. These notability may be attributed to the microorganisms inoculation, in the first place, reinforced the rhizosphere with these bacteria. Moreover, these microbial inoculations encourage plant growth either directly, by make plant hormones and improving nutrient uptake, or indirectly, by variable the microbial balance in rhizosphere in favor of the beneficial microorganisms Amara *et al* (1995) and Lazarovits and Nowak (1997). Furthermore, N-fixing bacteria (Netropein) promote the plant growth by N-fixing in the cultivated soil and or participate some growth hormones such as gibberellins, auxins and cytokinins Leaungvutiviroj *et al* (2010). Recently, this beneficial effect was concurrent with those obtained with (Shafeek *et al* 2004; Nishita and Joshi 2010, Mishra *et al* 2010, Karnan *et al* 2012, Hassan *et al* 2014 and Shafeek *et al* 2016).

Table 3: Effect of bio fertilizer doses and amino mix levels on growth characters of pea plant during 2016 and 2017 seasons.

Bio fertilizer	Amino mix	2016 season				2017 season			
		Plant length (cm)	Number of leaves/plant	Wight of (g)		Plant length (cm)	Number of leaves/plant	Wight of (g)	
				fresh	dry			fresh	dry
Without	0	10.00	7.00	8.90	1.58	10.67	7.67	8.93	1.29
	4 cm/L	10.83	7.67	9.62	1.61	11.67	8.33	10.50	1.46
	8 cm/L	11.33	8.33	11.17	1.84	12.67	8.67	11.77	1.77
mean		**10.72**	**7.67**	**9.90**	**1.68**	**11.67**	**8.22**	**10.40**	**1.51**
1 kg/fed at once dose	0	12.00	9.33	10.80	1.80	13.00	10.00	12.47	1.79
	4 cm/L	14.33	11.33	13.97	2.42	13.83	11.67	13.77	1.95
	8 cm/L	16.00	12.67	14.23	2.52	15.67	12.67	15.13	2.39
mean		**14.11**	**11.11**	**13.00**	**2.25**	**14.17**	**11.44**	**13.79**	**2.04**
1 kg/fed two doses	0	14.33	10.67	12.17	1.88	17.00	13.33	14.77	2.61
	4 cm/L	16.00	12.00	14.67	2.28	18.00	14.00	15.33	2.55
	8 cm/L	17.33	13.33	15.17	2.33	19.67	15.00	15.97	2.67
mean		**15.89**	**12.00**	**14.00**	**2.16**	**18.22**	**14.11**	**15.36**	**2.61**
Average	0	12.11	9.00	10.62	1.75	13.56	10.33	12.06	1.90
	4 cm/L	13.72	10.33	12.75	2.10	14.50	11.33	13.20	1.99
	8 cm/L	14.89	11.44	13.52	2.23	16.00	12.11	14.29	2.28
LSD at 5% level	Bio	**0.83**	**1.04**	**1.31**	**0.19**	**0.78**	**1.33**	**1.68**	**0.34**
	Amino	**0.48**	**0.37**	**0.49**	**0.16**	**0.29**	**0.38**	**0.43**	**0.14**
	interaction	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

These superiority by using bio-fertilizer by two doses raise the leaves of pea plant growth, increase the chlorophyll content and the photosynthesis of leaves, better the physiological metabolism of pea plants and become stronger physiological function of anti-senility, promote the photosynthetic organism to transfer to the plant root and increase the yield and starch content in the seeds but also decrease the soil unit weight, increase the holes percent of soil, promote microbe activity in the soil, increase the urease and the invertase activity of soil, promote the availability of nutrients, increase

content of organic matter, available nitrogen, phosphorus and potassium, and increase the ratio of utilization of fertilizer. It was effective way to apply the bio-fertilizer to pea for increasing the growth, yield and seeds content, improving the soil physical and chemical character and increasing the soil fecundity.

Effect of amino mix levels:

The consequence in Table (3) generally specific that, foliar spraying with amino mix for all levels gives the most significantly augmentation in plant growth parameters i.e. plant height (cm), number of leaves plant, fresh and dry weight of leaves compared without amino mix sprayed (spraying with water). Recently, amino mix at high level (8 cm/L) significantly improving plant growth characters of pea plants followed in descending order by that plants spraying by amino mix at (4 cm/L) followed by foliar spraying with water (control). These previous data were true in both experimental seasons. It could be concluded that, amino mix can directly or indirectly impact the physiological activities of the plant. Functionally, amino mix especially L- amino acids rather than Damino acids are involved in the enzymes responsible for the structural photosynthesis process. Also, amino mix have act as chelating effect on micronutrients, when applied together with micronutrients, the absorption and transportation of micronutrients inside the plant is easier (Ibrahim, 2010). The requirement of amino acids in essential quantities is well known as a mean to increase yield and overall quality of crops. The application of amino acids for foliar spray is based on their requirement by plants in general and critical stages of growth in particular. Plants absorb amino acids through stomata and are proportionate to environment temperature that controls the opening mechanism of the plant stomata. Also amino acids are fundamentals ingredients in the process of protein synthesis (Shafeek *et al* 2012). Same results also, recorder by Turky (2007), El-Ghamry *et al* (2009), Fawzy *et al* (2010), Abdel-Mawgoud *et al* (2011) and Shafeek *et al* (2016) found that, amino acid mix reflected the highest values for plant growth of legume plants. In the same respect, Ghaith and Galal (2014) stated that, foliar spraying with amino acid at the rate of 100 ppm produced the highest plant growth in pea plants.

Effect of the interaction:

The interaction between bio-fertilizer doses (Netropein) as well as foliar spraying of amino mix treatments showed in the Table (3), there were differences obtained on the interaction between placed on two batches of bio-fertilizer with high level of amino mix (8 cm/L) followed by the other treatments and control treatment. However, the statistical analysis of the obtained data reveals that the differences within different doses of bio-fertilizer with foliar spraying of amino mix treatments were not enough to reach the 5% level of significant on plant growth characters.

B- Total yield and its components:

Effect of bio fertilization doses :

The results approaching in Table (4) mean that the inoculation with bio-fertilizer (Netropein) at 1 kg\ fed. which was previously had highest significant simulative effects on pea plant growth had a similar positive influence on its total yield and caused declared increases as compare with non inoculation bio-fertilizers. It gave the highest number of pods/plant and total pods yield (ton/fed.) as well as the best physical properties of pod i.e., number of seeds/pod and weight of 100 seeds in the two studied seasons. However, the inoculation with they were placed on two batches of bio-fertilizer (Netropein) significantly increased total yield and its components compared placed at once. The notability in total pods yield per fed. reached 41.85 % and 61.45 % in 1 and 2 seasons respectively. Generally, the inoculation with bio-fertilizer (Netropein) enhanced total yield of pea pods. Such effect could be attributed to the role of bio-fertilizer that converts organic N form to mineral N form, which is more preferred by plants. In this concern, El-Karamany *et al* (2000) reported that the significant effect of bio-fertilizers may be due to the effect of different strain groups such as nitrogen fixers, nutrients mobilizing microorganisms which help in availability of metals and increased levels of

extractable N, P, K, Fe, Zn and Mn. The results of Fatma and Shafeek (2000), Hassan *et al* (2014) and Shafeek *et al* (2016) supported present results.

Effect of amino acid levels:

Data registered in Table (4) specific that total pods yield (ton/fed.) of pea plants are influenced by various amino acid mix treatments. Whereas, the highest values of total pods yield (ton/fed.) of pea plants and its components were obtained significantly increased with the high level of amino mix (8 cm/L) followed in descending order by that plants spraying by low level (4 cm/L) followed by control treatment (foliar spraying with water). These returns were true in both experimental seasons. The superiority in total pods yield per fed. reached 43.90 % and 40.97 % respectively in 1 and 2 seasons. The statistical analysis within different treatments was great enough to reach the 5% level. It be concluded that, improvement in plant growth and total yield due to the application of amino acid may be due to providing readily source of growing substances which form the constitutes of protein in the living tissues (Ghaith and Galal 2014) on pea plants. Our results are in harmony with those mentioned by Khalilzadeh *et al* (2012), reported that spraying amino acid at 36% significantly increased the number of seeds/pod, number of pods/plant, seed weight, seed yield and biological yield of bean plants.

Table 4: Effect of bio fertilizer doses and level of amino mix on yield characters of pea plant during 2016 and 2017 seasons.

Bio fertilizer	Amino mix	2016 season				2017 season			
		Yield ton/fed	N. of pods/plant	N. of seeds/pod	W. of 100 seeds	Yield ton/fed	N. of pods/plant	N. of seeds/pos	W. of 100 seeds
Without	0	0.95	13.00	6.33	32.10	0.85	13.00	5.67	34.40
	4 cm/L	0.97	14.00	6.67	35.90	0.92	13.67	6.33	35.10
	8 cm/L	1.30	14.00	7.00	36.57	1.10	14.00	7.00	35.97
mean		**1.07**	**13.67**	**6.67**	**34.86**	**0.96**	**13.56**	**6.33**	**35.16**
1 kg/fed at once doses	0	1.22	15.00	7.00	34.00	1.27	14.67	7.00	36.43
	4 cm/L	1.53	16.00	7.33	33.80	1.79	15.33	8.00	37.00
	8 cm/L	1.98	16.00	8.00	39.07	1.91	16.00	8.00	37.53
mean		**1.58**	**15.67**	**7.44**	**35.62**	**1.66**	**15.33**	**7.67**	**36.99**
1 kg/fed two doses	0	1.52	16.00	8.00	31.48	2.19	16.33	8.33	39.20
	4 cm/L	1.97	17.00	9.00	37.49	2.50	17.67	9.00	39.93
	8 cm/L	2.03	18.00	9.33	42.67	2.78	18.67	9.67	40.67
mean		**1.84**	**17.00**	**8.78**	**37.21**	**2.49**	**17.56**	**9.00**	**39.93**
Average	0	1.23	14.67	7.11	32.53	1.44	14.67	7.00	36.68
	4 cm/L	1.49	15.67	7.67	35.73	1.74	15.56	7.78	37.34
	8 cm/L	1.77	16.00	8.11	39.43	1.93	16.22	8.22	38.06
LSD at 5% level	Bio	**0.10**	**0.31**	**0.97**	**NS**	**0.18**	**1.13**	**0.62**	**0.41**
	Amino	**0.14**	**0.42**	**0.26**	**2.99**	**0.09**	**0.40**	**0.24**	**0.54**
	Interact.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Effect of the interaction:

The interaction between the inoculations of different doses of bio-fertilizer (Netropein) and the foliar application of amino mix are presented in (Table 4). Whereas, no significant interaction effect were obtained on total yield and its components Generally, the inoculations of placed on two batches of bio-fertilizer (Netropein) with high level of foliar spraying of amino mix (8 cm/L) produced the highest total pods yield and its components of pea plants.

C- Nutrition value:

Effect of bio fertilization doses :

The inoculation of bio-fertilizer (Netropein) caused an improvement in the nutritional values of dry pea seeds compared without bio-fertilizer as shown in Table (5). Whereas, placed on two batches of

bio-fertilizer gained the best nutritional values, i.e. the highest the percentage content of N, protein, P and K followed in descending order using placed at once followed without bio-fertilizer during the experimental seasons of 2016 and 2017. It could be concluded that, bio-fertilizers play a main key role for selective adsorption of immobile (P, Zn, Cu) and mobile (C, S, Ca, K, Mn, Cl, Br, and N) elements to plants (Tinker, 1984). These findings are in good accordance of that reported before by other investigators (Fatma and Shafeek 2000, Mishra *et al* 2010; Elham *et al* 2014, Hassan *et al* 2014 and Shafeek *et al* 2016).

Table 5: Effect of bio fertilizer doses and level of amino mix on chemical characters of pea plant during 2016 and 2017 seasons.

Bio fertilizer	Amino mix	2016 season				2017 season			
		%							
		N	P	K	protein	N	P	K	protein
Without	0	1.63	0.42	1.29	10.21	1.57	0.39	1.20	9.65
	4 cm/L	1.75	0.49	1.37	10.94	1.70	0.40	1.28	10.63
	8 cm/L	1.83	0.52	1.41	11.46	1.80	0.45	1.36	10.90
mean		**1.74**	**0.47**	**1.36**	**10.87**	**1.69**	**0.41**	**1.28**	**10.39**
1 kg/fed at once dose	0	1.87	0.52	1.39	11.67	1.91	0.49	1.40	11.58
	4 cm/L	2.05	0.57	1.52	12.81	2.07	0.52	1.43	13.11
	8 cm/L	2.19	0.59	1.60	13.71	2.24	0.54	1.52	13.93
mean		**2.04**	**0.56**	**1.5**	**12.73**	**2.07**	**0.52**	**1.45**	**12.87**
1 kg/fed two doses	0	2.00	0.58	1.48	12.50	2.30	0.57	1.57	13.88
	4 cm/L	2.18	0.67	1.68	13.65	2.23	0.60	1.66	14.65
	8 cm/L	2.30	0.73	1.75	14.38	2.40	0.65	1.73	14.98
mean		**2.16**	**0.66**	**1.64**	**13.51**	**2.31**	**0.61**	**1.65**	**14.50**
Average	0	1.83	0.51	1.39	11.46	1.93	0.48	1.39	11.71
	4 cm/L	1.99	0.57	1.52	12.47	1.99	0.51	1.45	12.79
	8 cm/L	2.11	0.61	1.59	13.18	2.15	0.55	1.54	13.27
LSD at 5% level	Bio	**0.09**	**0.03**	**0.05**	**0.58**	**0.08**	**0.01**	**0.03**	**0.23**
	Amino	**0.04**	**0.02**	**0.03**	**0.23**	**0.06**	**0.01**	**0.02**	**0.38**
	Interact.	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Effect of amino acid levels:

Data regarded in Table (5) reported that, foliar spraying of amino mix treatments significantly increased the nutritional value of dry seeds of pea expressed as the percentage of N, Protein, P and K contents in both seasons. However, high level of amino mix at (8 cm/L) gave the maximum content of nutritional value of dry seeds of pea. Also, the next highest result obtained with foliar spraying of amino mix at (4 cm/L). On the contrary, the lowest value of nutrition obtained with foliar spraying with water. However, amino acids have act as chelating effect on micronutrients, when applied together with micronutrients, the absorption and transportation of micronutrients inside the plant is easier (Ibrahim, 2010). The obtained results are come to the same conclusion with El-Ghamry *et al* (2009), Abdel-Mawgoud *et al* (2010), Khalilzada *et al* (2012), Ghaith and Galal (2014) and Shafeek *et al* (2016) on legume crops.

Effect of the interaction:

Treatments of the interaction between different inoculation bio-fertilizer doses with foliar spraying of the different levels of amino mix presented in Table (5). Moreover, the statistically analysis of the obtained data reveals that, the differences within various treatments were no great enough to reach the 5% level of significant. These findings were completely similar in both seasons of 2016 and 2017.

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