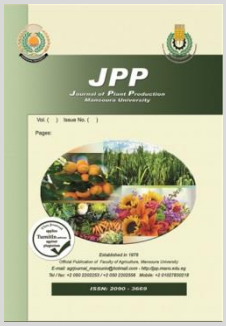
Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

Influence of Spraying with Amino Acids and Phosphorus Fertilization on Productivity and Quality of Chickpea

El-Said, M. A. A.* and H. A. Ahmed

Dept. of Agron., Fac. of Agric., Al-Azhar Univ., Assiut, Egypt.



ABSTRACT

This work was performed out during the two consecutive winter seasons of 2018/2019 and 2019/2020 in the Research Farm at the Faculty of Agriculture, Al-Azhar Univ., Assiut, Egypt, to study the effect of different rates of phosphorus fertilizers (15.5, 31 and 46.5 Kg. P_2O_5/fed.) and foliar with amino acids (control, 2 and 4 cm^3/L) on growth, yield and its components and seed quality of chickpea cv. Giza-195. The experiments were performed in a split- plot design with three replicates; where phosphorus rates were assigned to the main plot while amino acids were distributed randomly in sub- plot.The obtained results showed that increasing the phosphorus fertilization rates from 15.5, 31 and 46.5 kg P_2O_5/fed caused a significant increase in all traits under study in both seasons.amino acids foliar increase of application from 0, 2 to 4 cm/L caused significant and gradual increases in all studied characters, *i.e.* plant height, number of branches and pods/plant, 100-seed weight, seed yield/plant, as well as seed and straw yields/fad. This application also, increased protein percentages in seeds.The study recommended that phosphate fertilization at a rate of 46.5 kg P_2O_5/fed and spraying with amino acids at a concentration of 4cm/L to obtain the highest yield from the faddan and the highest quality of seeds under Assiut conditions.

Keywords: chickpea, amino acids, number of branches, seed yield, protein.

INTRODUCTION

The legume family consists of about 440 genera and 12,000 species. It ranks only second Vegetarianism Graminia in agricultural importance (Cronquist, 1981). Phosphorus is the second most commonly soil limiting nutrient element after nitrogen. Soil supply with phosphorus is very important practice for legumes where it is considered the most important nutrient limiting pulse production. A vigorous plant growth, coupled with greater assimilates formation and translocation to plant fruiting parts, resulting in a better development for seed yield and its components are consequences for supplying legume plants with phosphorus at optimum rates (Parihar and Tripathy, 1989). However, phosphorus application of more or less than optimum was associated with reduction in seed yield due to much rapid or late maturity at the expense of seed filling during maturity period. Ahmed and Badr (2009) indicted that use phosphate fertilizer at a rate of 46.5 kg P_2O_5 /fed it resulted in a significantly increase in the length of chickpeas, yield and it components and protein percentage compared to 15.5 and 31.0 kg kg P_2 O_5 /fed. Bicer (2014) indicated that there are significant differences in yield and yield components (number of branches, pods and yield/plant) by increasing phosphate fertilization rates. Shabeer *et al.* (2015) revealed that growth, yield and yield components of chickpea were significant at ($P<0.05$) and positively affected by increasing phosphorus rates. Chauhan and Bhoopendra (2017) revealed that increasing phosphorus fertilizers to 60 kg P_2O_5/ha. Significantly increased the attributes of growth (plant height and branches no./plant,) yield attributes and yield (pods no./plant, 1000 seed weight) and yield of chickpea over control. Mahmoud and Mohammed (2018) showed that increasing rates of phosphorus fertilizers led to a significant increase in (number of pods/plant, 100-seed weight, seed yield, straw yield and total crude protein) of chickpea.

The importance of amino acids is due to their widespread use in the biosynthesis of a large variety of non-protein nitrogenous substances, *i.e.* dyes, coenzymes, purine, and vitamins pyrimidine bases. Research has shown that amino acids can directly or indirectly affect the physiological processes in plant growth, yield and quality (Mohamed 2006). Siamak *et al.* (2014) showed that plant biomass was greatly increased through salicylic acid and ascorbic acid application. The salicylic acid spry was significantly increased in the case of complete drought stress condition of the number of pods and seed yield of chickpea. Shafeek *et al.* (2018) showed that foliar application by high concentration of amino mix (8 cm/L) significantly improved the most plant growth characters, total yield and its components of pea as well as the seeds contents of the percentage of protein followed in descending order by that plants spraying by 4 cm/L followed with foliar spraying with water. Amin *et al.* (2018) indicated that spraying application of benzoic acid, ascorbic acid, fuluvic acid and Humic acid on chickpea cv-195, lead to overall better performance of the plant and increase the growth, protein and yield, as well as, its components compared with untreated plant (control treatment). Jahangir *et al.* (2019) found that characters as: number of branches/plant, number of pods/plant, number of seeds/pod, 100- seed weight, grain yield, biomass, protein percent and protein yield were significantly affected by the application of pluramin amino acid of chickpea.

* **Corresponding author.**
E-mail address: mabdelaziz981@gmail.com
DOI: 10.21608/jpp.2021.154335

The main target of this investigation is to evaluate of growth characteristics, yield, its components and quality of chickpea seeds as affected by different phosphorus fertilizer rates and foliar application with amino acids under Assiut Governorate conditions.

MATERIALS AND METHODS

Two field experiments were conducted at the Agricultural Experimental Farm of Al-Azhar Univ. at Assiut, during 2018/2019 and 2019/2020 seasons to study the response of chickpea to different rates of phosphorus fertilizers 15.5, 31 and 46.5 P_2O_5/fed and spraying application with amino acids (control, 2 and 4 cm^3/L) on productivity and quality. The design used is a randomized completed blocks design in split- plot arrangement with three replicates; where phosphorus rates were assigned to the main -plots, while amino acids were distributed randomly in sub -plot. Use a phosphorus fertilizer as calcium super phosphate (15.5% P_2O_5) and added on soil surface during soil preparation the foremen tied at rates. Foliar application of amino acids levels (control, 2 and 4 cm/L) were sprayed two times, the first one after 20 days from sowing and the second a month after the first foliar application. A chickpea seed of cultivar Giza-195 was planted on 12th November in two growing seasons, after inoculation with root nodules bacteria (*Rhizobium leguminosarum*). The experimental unit consists five ridges, each 350 cm long and 60 cm wide (10.5 m^2 in area = 1/400 faddan - faddan = 4200 m^2). Seeds were sown in a community of 140 thousand plants/fad were sown on the two sides of rows, in hills 10 cm apart and thinned to one plants/hill. The commercial product used "Amino plus" as compound source mimicking the amino acids mixture. "Amino plus" is a brown liquid with pH of 5.5 and containing amino acids mixture as follows (g/100 ml solution); Threonine (1.02), Aspartic (1.56), Serine (2.21), Glutamic (2.62), Proline (2.55), Valine (1.74), Glycine (1.78), Alanine (1.41), , Leucine (1.77), Isoleucine (1.07), Tyrosine (0.40), , Histidine (0.14), Lysine (0.33), Arginine (1.66), Phenylalanine(0.94), Cystine (0.87) and Methionine (0.08). The remaining agricultural transactions were carried out as recommended in the region. The chemical and physical analyses of the experimental site are presented in Table 1.

Table 1. The chemical and physical analyses of the experimental site.

Physical analysis	2018/2019	2019/2020	Chemical analysis	2018/2019	2019/2020
Sand (%)	25.80	25.50	Organic matter (%)	0.99	1.00
Silt (%)	37.80	38.40	Available N (ppm)	73.40	75.50
Clay (%)	36.40	36.10	Available P(ppm)	9.40	9.56
			Exchangeable K (ppm)	335.15	343.25
Soil texture	Clay loam		pH	7.62	7.85
			E.C. (ds. m^{-1})	1.10	1.12
			Total CaCo3 (%)	2.65	2.52

Studied characters:

A- Yield and yield components:

Upon harvesting, samples of 10 plants were randomly selected from indoor rows and the following readings were taken:

1- Plant height (cm)
2- Number of pods / plant.
3- Number of branches / plant.
4- 100- seed weight (g).
5- Seed yield /plant (g).
6- Seed yield (kg/fad)
7- Straw yield (ton/fad.). Yields of seeds and straw were recorded on a plants/ plot basis. The values recorded were used to estimate the corresponding values /faddan.

B- Chemical analysis:

Upon harvesting, seed samples were ground and preserved for chemical analysis as follow;

Protein percentage:

The total nitrogen content in the seeds was analyzed using the Microkjeldahl method as described by A.O.A.C (1980) and the protein percentage was calculated by multiplying the nitrogen percentage by 6.25.

Statistical analysis:-

Data were analyzed statistically according to Gomez and Gomez (1984) using computer statistical analysis software MSTAT-C by Freed *et al.* (1989). The least significant differences (LSD) test at probability level of 0.05 was manually calculated to compare the differences among treatments means.

RESULTS AND DISCUSSION

A- Yield and yield components:-

1– Effect of phosphorus fertilization:

As shown in Tables (2, 3, 4, 5, 6, 7 and 8) results indicated that increasing phosphorus rates from 15.5, 31 to 46.5 kg P_2O_5 /fed significantly increased yield and yield components in both growing seasons. Maximum values plant height, number of branches / plant, number of pods / plant, seed yield /plant, 100- seed weight, seed yield (kg/fad) and straw yield (ton/fed.) were observed with adding 46.5 kg P_2O_5 /fed. The increase in these characters with the increase of phosphorus level might due to the role of phosphorus in activating the growth and yield components. These results might be attributed to the role of phosphorus as a constituent of all important nucleo-porteins and thus increases the efficiency of root system. Consequently the physiological activities of the plant are enhanced leading to better yield. Also, may be due to effect of phosphorus fertilizer on increasing plant growth and the percentage of flowering and setting which increased the number of pods and seed/plant, seed index and seed yield/plant and decreased the percentage of flowers and pods abscission. These results are in line with those obtained by Ahmed and Badr (2009) and Mahmoud and Mohammed (2018).

2 – Effect of foliar with amino acids:

Data in Tables (2, 3, 4, 5, 6, 7 and 8) reveal that foliar spraying chickpea plants with amino acids

significantly increased yield and its components (plant height, number of branches/plant, number of pods / plant, seed yield /plant, 100- seed weight, seed yield (kg./fad.) and straw yield (ton/fed.)) in both seasons. The highest mean values are recorded in plants treated with amino acids 4 cm/L. The positive effect of amino acids on yield and its components may be attributed the importance of amino acids is due to their widespread use in the biosynthesis of a large variety of non-protein nitrogenous substances, *i.e.* dyes, coenzymes, purine, and vitamins pyrimidine bases. Studies have proved that amino acids can directly or indirectly influence the physiological activities in plant growth and yield (Mohamed 2006). These results are similar to those reported by Shafeek *et al.* (2018) and Jahangir *et al.* (2019).

Table 2. Effect of phosphorus fertilization, amino acids spraying and their interaction on plant height (cm) of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	70.60	73.57	75.33	73.16	71.27	74.07	76.00	73.78
31	74.20	77.63	80.33	77.39	75.20	78.30	81.13	78.21
46.5	78.57	80.67	84.77	81.33	79.30	82.07	86.43	82.60
Mean	74.46	77.29	80.14		75.26	78.14	81.19	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.52		*		0.60	
Amino acids(A)	*		0.65		*		0.58	
P X A	*		0.63		*		1.00	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

Table 3. Effect of phosphorus fertilization, amino acids spraying and their interaction on Number of branches/plant of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	3.40	4.26	4.80	4.16	3.63	4.60	5.00	4.41
31	4.20	4.73	5.13	4.69	4.40	4.90	5.50	4.93
46.5	4.80	5.23	5.80	5.28	4.90	5.43	5.90	5.41
Mean	4.13	4.74	5.24		4.31	4.98	5.47	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.05		*		0.14	
Amino acids(A)	*		0.04		*		0.10	
P X A	*		0.08		*		0.18	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

Table 4. Effect of phosphorus fertilization, amino acids spraying and their interaction on Number of pods/plant of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	49.67	55.60	59.50	54.92	50.07	56.70	59.90	55.56
31	55.93	60.43	63.60	59.99	56.56	60.97	64.33	60.62
46.5	59.60	63.40	67.70	63.57	60.27	64.37	68.57	64.40
Mean	55.07	59.81	63.60		55.63	60.68	64.27	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.23		*		0.49	
Amino acids(A)	*		0.15		*		2.80	
P X A	*		0.27		*		0.48	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

Table 5. Effect of phosphorus fertilization, amino acids spraying and their interaction on Seed yield /plant (g) of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	18.60	20.75	22.20	20.52	19.22	21.43	23.54	21.40
31	20.75	23.18	24.22	22.72	21.43	24.54	25.59	23.85
46.5	22.18	24.52	26.20	24.30	23.65	25.89	28.17	25.91
Mean	20.51	22.82	24.20		21.44	23.96	25.77	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.03		*		0.04	
Amino acids(A)	*		0.06		*		0.02	
P X A	*		0.05		*		0.03	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

Table 6. Effect of phosphorus fertilization, amino acids spraying and their interaction on 100-seed weight (g) of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	19.34	19.71	20.28	19.78	19.53	19.92	20.82	20.09
31	19.85	20.55	20.95	20.44	20.45	20.93	21.54	20.98
46.5	20.45	21.15	21.98	21.19	20.84	21.65	22.15	21.55
Mean	19.88	20.47	21.07		20.28	20.84	21.50	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.02		*		0.24	
Amino acids(A)	*		0.01		*		0.19	
P X A	*		0.04		-		N.S	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

Table 7. Effect of phosphorus fertilization, amino acids spraying and their interaction on Seed yield (Kg /fad.) of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels (kgP2O5/fad)	Amino acids			Mean	Amino acids			Mean
	A0	A1	A2		A0	A1	A2	
15.5	684.33	714.33	731.00	709.89	689.33	717.33	736.00	714.22
31	741.00	781.00	807.00	776.33	748.00	788.67	811.00	782.56
46.5	761.00	803.33	841.33	801.89	766.00	801.33	838.00	801.78
Mean	728.78	766.22	793.11		734.44	769.11	795.00	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		2.23		*		1.59	
Amino acids(A)	*		1.21		*		1.25	
P X A	*		2.10		*		2.17	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

Table 8. Effect of phosphorus fertilization, amino acids spraying and their interaction on Straw yield (ton/fad.) of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	1.111	1.131	1.161	1.13	1.151	1.192	1.212	1.185
31	1.151	1.181	1.214	1.18	1.193	1.214	1.260	1.222
46.5	1.194	1.241	1.284	1.24	1.217	1.273	1.312	1.267
Mean	1.15	1.18	1.22		1.187	1.227	1.261	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.002		*		0.005	
Amino acids(A)	*		0.001		*		0.004	
P X A	*		0.002		*		0.003	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

3 – Interaction effects:

Results in Tables (2, 3, 4, 5, 6, 7 and 8) indicated that the interaction between (phosphorus x amino acids) all characteristics were significant in both seasons, except for the weight of 100-seeds the interaction was significant in the first season only. The highest values in all characters were obtained when with fertilized 46.5 kg P_2O_5/fad and foliar with amino acid (4cm/L) in both seasons.

B- Chemical analysis:

1– Effect of phosphorus fertilization:

Illustrated data in Table 9 clearly indicated that phosphorus fertilizer rates had significantly increased protein percentage in both seasons. The highest values were obtained when phosphorus was applied at a rate of 46.5 kg P_2O_5 /fed. during 2018/2019 and 2019/2020 seasons. These results might be due to the beneficial effect of phosphorus fertilizer on fabacea crops due to its role in activation the microbial population in nodules to fix more nitrogen that used by plants in protein synthesis. These results are in accordance with those found by Ahmed and Badr (2009) and Mahmoud and Mohammed (2018).

2 – Effect of foliar with amino acids:

Presented data in Table 9 revealed that foliar spraying chickpea plants with amino acids significantly increased protein percentage in two seasons. The highest mean values are recorded in plants treated with amino acids 4 cm/L. These results are in accordance with this found by Shafeek *et al.* (2018) and Amin *et al.* (2018).

3 – Interaction effects:

The presented data in Table 9 revealed that protein % was significantly affected by the interactions of (phosphorus x amino acids) in the two seasons. The highest protein percentage values (27.14 and 27.41 %) were obtained when with fertilized 46.5 kg P_2O_5/fad. and foliar with amino acid (4cm/L) in both seasons.

Table 9. Effect of phosphorus fertilization, amino acids spraying and their interaction on Protein % of chickpea in 2018/2019 and 2019/2020 seasons.

Seasons	2018/2019				2019/2020			
P-levels	Amino acids			Mean	Amino acids			Mean
(kg P_2O_5/fad.)	A_0	A_1	A_2		A_0	A_1	A_2	
15.5	24.81	25.22	26.14	25.39	24.99	25.43	26.20	25.54
31	25.43	25.94	26.26	25.88	25.52	26.14	26.76	26.14
46.5	25.95	26.61	27.14	26.57	26.17	26.94	27.41	26.84
Mean	25.40	25.92	26.51		25.55	26.17	26.79	
	F test		L.S.D. at 0.05		F test		L.S.D. at 0.05	
Phosphorus (P)	*		0.01		*		0.02	
Amino acids(A)	*		0.01		*		0.02	
P X A	*		0.02		*		0.03	

A_0= control - A_1= 2cm/L - A_2= 4cm/L

CONCLUSION

Under conditions of the present work, the highest value of seed yield/fad and quality were obtained from chickpea cv. Giza-195 when received 46.5 kg P_2O_5 /fed and foliar with amino acids at 4 cm/L.

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تأثير الرش بالأحماض الأمينية والتسميد الفوسفاتي علي إنتاجية وجودة محصول الحمص

محمد عبد العزيز أحمد السيد و حجاجي عبد الحفيظ احمد

قسم المحاصيل ـ كلية الزراعة ـ جامعة الأزهر بأسيوط

أقيمت تجربتان حقليتان بمزرعة كلية الزراعة - جامعة الأزهر بأسيوط خلال موسمي ٢٠١٨/٢٠١٩ و ٢٠١٩/٢٠٢٠ لدراسة استجابة الحمص صنف جيزة -١٩٥ للرش بالاحماض الامينية (امينو بلس) (صفر ، ٢ و٤ سم/لتر) والتسميد الفوسفاتي (١٥,٥, ٣١ و ٤٦,٥ كجم فو٢أ٥/ فدان) وأثر ذلك علي المحصول وجودته. وقد استخدم تصميم القطاعات المنشقة مرة واحدة في ثلاث مكررات حيث وزعت معدلات التسميد الفوسفاتي في القطع الرئيسية بينما وزع الرش الورقي بالاحماض الامينية علي القطع المنشقة. وقد أظهرت النتائج المتحصل عليها الي ان زيادة معدلات التسميد الفوسفاتي من ١٥,٥, ٣١ إلي ٤٦,٥كجم فو٢أ٥/ فدان ادت إلي زيادة معنوية في كل الصفات تحت الدراسة في كلا الموسمين. أدي الرش بالأحماض الأمينية باعلي تركيز إلي زيادة معنوية في طول النبات عدد الأفرع القرون ومحصول البذور للنبات ووزن ال١٠٠ بذرة ومحصول البذور والقش للفدان و النسبة المئوية للبروتين في البذور في كلا الموسمين . وبصفة عامة توصي الدراسة اضافة السماد الفوسفاتي بمعدل ٤٦,٥ كجم فو٢أ٥/فدان مع الرش الورقي بالاحماض الامينية بتركيز ٤ سم /لتر وذلك لتحقيق أعلي محصول وجودة من صنف الحمص جيزة- ١٩٥ تحت ظروف محافظة اسيوط.