The Influence of Interaction between the Phosphorus Fertilizer and Gibberellin on Elements Content of Lentil Crop (Lens culinaris Medic.)

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Abstract

An experiment was conducted in the greenhouse of Biology Department, College of Education (Ibn Al-Haithum), University of Baghdad, during the growing season 2009, by using plastic pots with capacity of two Kg of soil. The aim of the research was to s tudy the effect of different levels of diamonium phosphate fertilizer as phosphorus source and increased concentrations of gibberellin on elements content N, P, K, Ca and soluble carbohydrate percentage in vegetative part of lentil cultivar (Barka). Treatments comprised of three levels of fertilizer (0, 0.16, 0.32) g/pot this equal to (0, 40, 80) kg/do., three concentrations of GA_3 (0, 50, 100)ppm and their interaction. The factorial experiment according to complete randomized design with three replicates. Results showed that significant differences by increase fertilizer levels, gibberellin concentrations and their interaction. The preference was for interaction of two mentioned above factors more than each one alone. Treatment with (0.32 g/ pot fertilizer and 100ppm gibberellin) gave the highest content of elements studied as compared with other treatments, since treatment with (0.32 g/ pot fertilizer and 50 ppm gibberellin) gave the highest soluble carbohydrate percentage as compared with other treatments.

Keywords: DAP fertilizer, GA_3 and lentil.

Introduction

Phosphorus is one of the most essential elements for the plant after nitrogen since it plays a significant role in several physiological and biochemical plants activities (1). However, the avaibility of this element for plants is limited because of different reasons like: slow mobility in the soil, interaction with other elements and soil pH (2), therefore it's recommended to use different phosphorus fertilizers to enhancement growth of plant.

Hussaini et al. (3) showed that the level 40 kg/do. of single super phosphate fertilizer significantly increased N, P,K, Ca content in maize. Zeidan (4) founded that the level 60kg/do. of triple super phosphate fertilizer significantly increased N, P and K content in lentil. Similar results showed for other researchers such as Mehrvarz and Chaichi in Barley (5) and Al-Gizawy and Mehasen in Faba Bean (6). Studies also noted that gibberellin (GA_3) hormone is active elements uptake and organic compounds building. Ibrahim et al. (7) showed that 100 ppm of GA_3 gave a significant increase in N, P and K contents in Faba Bean. Abbas (8) and Al-Saedy et al. (9) showed that 75 ppm of GA_3 caused a significant increase in carbohydrate of fenugreek and wheat respectively.

Thus, this investigation aimed to study the effect of different levels of diamonium phosphate fertilizer, GA_3 and their interaction on some elements content and soluble carbohydrate percentage of lentil crop cv. Barka.

Materials and Methods

* *Experimental Site and Soil Characteristics:*

This study was conducted in the greenhouse of Biology department, College of Education (Ibn Al-Haithum), University of Baghdad during the growing season 2009, to study the effect of three phosphate fertilizer levels (0, 0.16, 0.32) g/pot, three gibberellin (GA_3) concentrations (0, 50, 100) ppm and their interaction on some elements content (N, P, K and Ca) and soluble carbohydrate percentage of lentil crop (Lens culinaris Medic.)cv. Barka.

The Soil was brought from the biotic garden of department and cleaned by filtering through 2 mm sieve.

Some physical and chemical characters of the used soil analyzed according to Page et al. (10) and Table (1) showed the characters of soil.

Table (1)
Some physical and chemical analysis of the investigated soil.

Soil Particles (g/kg soil)			*Organic Matter g/kg soil*	*$CaCO_3$ (%)*	*pH*	*E.C. (ds/m)*	*Texture*	*N (g/Kg soil)*	*P (ppm)*	*Fe (ppm)*
Clay	*Silt*	*Sand*					*Loam Slity*			
201	530	260	8.50	20.50	7.5	2.35		8.40	7.60	9.90

**** Treatments and Experimental Design:***

The experiment included 27 treatments (experimental units):

1-Three levels of diamonium phosphate (DAP) (46%P, 18% N):- (0,0.16,0.32)g/pot this equal to (0,40,80)kg/do. respectively, added before planting.

2-Three concentrations of GA_3:- (0, 50, 100) ppm. Prepared from stock solution (dissolved 1 gm of GA_3 in 1000 ml of D.W. and some drops of NaOH (1N) added in order to spread the hormone on the surface of the leaves) (11).

3-Three replicates.

The biological experiment was designed according to the complete randomized design (CRD).

Fourteen seeds were sown in each pot on 19/11/2009 and dissolved after germination to remained six plants at each pot the concentrations of GA_3 mention above sprayed once on leaves at the stage of 3-4 leaves. Spraying processes were carried out during the morning until the solutions were run off all plants by using a manual sprayer.

The first harvest was taken after 63 days (H_1-D_{63}) and the second harvest was taken after 83 days (H_2-D_{83}) from sowing (three plants for each harvest), oven dried at 65-70 ^oC for 48 hours and the dry weights were recorded, then digest 0.2 gm of dry sample for chemical analysis (12).

Contents of N, P, K and Ca in vegetative part was determined as follows as: N% was determined by the microkjeldahl methods (13), P% was determined by using spectrophotometer (14), K% was determined by using flame photometer (10) and Ca% was determined according (15), than calculated the elements content according to the equation:

Element content (mg/g) = Element concentration (%) × Total dry weight×10 (13).

Soluble carbohydrate percentage determined by using phenol sulfuric acid method (16).

The least significant difference (LSD) was used to compare between means (17).

Results and Discussion

In Tables (2, 3, 4, 5) it can be observed that there was a significant increase in the N, P, K and Ca contents in vegetative part with increase of phosphorus fertilizer without GA_3 sprayed, GA_3 sprayed without phosphorus fertilizer and the interaction in both harvests.

In the phosphorus fertilizer without GA_3 sprayed, the significant increasing in the N, P, K and Ca contents means in both harvests from (0 to 0.32) g/pot at rate of (N: 235.01, 125.52%), (P: 130.58, 93.79%), (K: 225.25, 181.88%) and (Ca:184.32, 152.32%). In the GA_3 sprayed without phosphorus fertilizer, observed that the increasing in GA_3 concentrations from (0 to 100) ppm led to a significant increasing in the N,P,K and Ca contents means in both harvests at rate of (N: 52.29, 47.12%), (P: 36.01, 32.65%), (K: 76.70, 69.29%) and (Ca: 58.64, 54.66%).

It can be noticed that the increasing in the phosphorus fertilizer with GA_3 sprayed interaction from (0 g/pot fertilizer and 0 ppm GA_3) to (0.32 g/pot fertilizer and 100 ppm GA_3) led to high significant increasing in the N, P, K and Ca contents in both harvests at rate of (N: 449.18, 237.28%), (P: 256.54, 173.39%), (K: 563.49, 411.54%) and (Ca: 423.01, 314.75%).

The results mentioned above in tables illustrate that best values were observed in (80 g/pot fertilizer and 100 ppm GA_3) treatment compared with other treatments.

The increase of N,P,K and Ca contents may be due to the effect of phosphorus fertilizer on increasing biomaterial building like:- amino

and nucleic acids, nucleotides, phospholipids and enzymes, thus this requires increase nutrients uptake from soil to plant (1). Also, phosphorus is important in developing good root system of lentil plants and capacity of root to absorbance more N,P,K and Ca accordingly their contents increased by phosphorus application (18).

Besides, GA_3 has effect the increasing of cell division and cell enlargement, merstiamtic zones activation and bioactivities like:- increase permeability of membranes (19). Therefore, that require increase nutrients uptake from soil to plant.

The results agreed with those obtained by Hussaini et al. in maize (3), Zeidan in lentil (4), Mehrvarz and Chaichi in barley (5) and Ibrahim et al. in Faba bean (7).

Table (2)
Effect of DAP fertilizer, GA_3 sprayed and the interaction on nitrogen content (mg/g) of lentil crop.

DAP Fertilizer level (g/pot)	***GA_3 concentration (ppm)***							
	H_1-D_{63}				***H_2-D_{83}***			
	0	***50***	***100***	***Average***	***0***	***50***	***100***	***Average***
0	10.41	15.99	19.01	15.14	44.72	54.60	60.23	51.85
0.16	20.86	24.89	33.39	26.38	64.31	72.45	78.77	71.84
0.32	40.68	54.30	57.17	50.72	82.79	130.65	137.34	116.93
Average	23.98	31.73	36.52		62.61	85.90	92.11	
LSD (0.05)	GA_3 = 0.17 DAP = 0.17 GA_3× DAP= 0.29				GA_3 = 0.23 DAP = 0.23 GA_3× DAP= 0.40			

Table (3)
Effect of DAP fertilizer, GA_3 sprayed and the interaction on phosphorus content (mg/g) of lentil crop.

DAP Fertilizer level (g/pot)	***GA_3 concentration (ppm)***							
	H_1-D_{63}				***H_2-D_{83}***			
	0	***50***	***100***	***Average***	***0***	***50***	***100***	***Average***
0	1.68	2.60	2.97	2.42	6.54	8.06	9.08	7.89
0.16	3.15	3.95	4.74	3.95	10.62	13.82	12.15	12.20
0.32	5.25	5.50	5.99	5.58	12.32	15.66	17.88	17.88
Average	3.36	4.02	4.57		9.83	12.51	13.04	
LSD (0.05)	GA_3 = 0.20 DAP = 0.20 GA_3×DAP = 0.34				GA_3 = 0.17 DAP = 0.17 GA_3×DAP = 0.29			

Table (4)
Effect of DAP fertilizer, GA_3 sprayed and the interaction on potassium content (mg/g) of lentil crop.

DAP Fertilizer level (g/pot)	GA_3 concentration (ppm)							
	H_1-D_{63}				H_2-D_{83}			
	0	50	100	Average	0	50	100	Average
0	8.08	13.63	17.75	13.15	25.74	35.88	39.60	33.74
0.16	18.27	22.75	32.64	24.55	41.01	48.51	57.26	48.93
0.32	32.15	42.20	53.61	42.77	68.26	84.37	131.67	94.77
Average	19.62	26.19	34.67		45.00	56.25	76.18	
LSD (0.05)	GA_3 = 0.17 DAP = 0.17 GA_3×DAP = 0.29				GA_3 = 0.13 DAP = 0.13 GA_3×DAP = 0.23			

Table (5)
Effect of DAP fertilizer, GA_3 sprayed and the interaction on calcium content (mg/g) of lentil crop.

DAP Fertilizer level (g/pot)	GA_3 concentration (ppm)							
	H_1-D_{63}				H_2-D_{83}			
	0	50	100	Average	0	50	100	Average
0	7.30	11. 86	14.32	11.16	30.38	39.00	47.58	38.99
0.16	16.87	20.16	26.78	21.27	59.00	58.94	74.61	64.18
0.32	25.80	31.20	38.18	31.73	71.10	97.90	126.00	98.33
Average	16.66	21.07	26.43		53.49	65.20	82.73	
LSD (0.05)	GA_3 = 0.27 DAP = 0.27 GA_3×DAP = 0.47				GA_3 = 0.24 DAP = 0.24 GA_3×DAP = 0.41			

Also, data presented in Table (6) showed that there was significant increasing in the soluble carbohydrate percentage with the increasing in each of phosphorus fertilizer without GA_3 sprayed, GA_3 sprayed without phosphorus fertilizer and their interaction in both harvests, respectively.

In the phosphorus fertilizer without GA_3 sprayed, there was significant increasing in soluble carbohydrate percentage for 0.32g/pot level which were (4.37, 3.06%) in both harvests, respectively. While, the least was observed in the 0 g/pot level which were (2.17, 1.80%) in both harvests, respectively.

The same table showed that all concentrations of GA_3 affected significantly on soluble carbohydrate percentage. The highest average recorded at 100 ppm concentration with increasing ratio reached to (45.16, 27.27%) in both harvests, respectively compared with 0 ppm concentration.

Table (6) showed clearly that the interaction between phosphorus fertilizer and GA_3 sprayed was significant for both harvests, and highest value recorded in treatment (0.32 g/pot fertilizer and 50 ppm GA_3) which reached to (4.66, 3.22%) in both harvests, respectively. While, the lowest recorded in treatment (0 g/pot fertilizer and 0 ppm GA_3) in both harvests.

The positive response of lentil plants (increase soluble carbohydrate percentage) to phosphorus fertilization may be due to increase of nutrients uptake which builds carbohydrate, photosynthesis rate and enzymes activity (2). While, GA_3 affected on increase of leaf

expansion, delay senescence and nutrients uptake which builds carbohydrate (20). The results agreement with Al-Gizawy and Mehasen in Faba Bean (6), Abbas in fenugreek (8) and Al-Saedy et al. in wheat (9).

Table (6)
Effect DAP fertilizer, GA_3 sprayed and the interaction on soluble carbohydrate percentage (%) of lentil crop.

DAP Fertilizer level (g/pot)	*GA_3 concentration (ppm)*							
	H_1-D_{63}				*H_2-D_{83}*			
	0	*50*	*100*	*Average*	*0*	*50*	*100*	*Average*
0	1.17	2.34	3.01	2.17	1.07	1.88	2.45	1.80
0.16	2.13	2.77	3.51	2.80	2.10	2.22	2.68	2.33
0.32	4.15	4.66	4.29	4.37	3.11	3.20	2.86	3.06
Average	2.48	3.26	3.60		2.09	2.43	2.66	
LSD (0.05)	GA_3 = 0.08 DAP = 0.08 GA_3×DAP= 0.14				GA_3 = 0.13 DAP = 0.13 GA_3×DAP = 0.23			

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وبثلاث مكررات. اظهرت النتائج وجود فروق معنوية بزيادة مستويات التسميد وتراكيز الجبرلين وتداخلهما، وكانت الافضلية للتداخل العاملين اعلاه مما هي على الانفراد، واعطت المعاملة (0.32 غم/ أصيص سماد و 100 جزء من المليون جبرلين) افضل محتوى للعناصر المدروسة عن بقية المعاملات الاخرى، بينما اظهرت المعاملة (0.32 غم/ أصيص سماد و 50 جزء من المليون جبرلين) افضل قيمة للنسبة المئوية للكربوهيدات الذائبة عن بقية المعاملات الاخرى.

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الخلاصة

نفذت التجربة في البيت الزجاجي التابع لقسم علوم الحياة، كلية التربية/ ابن الهيثم، جامعة بغداد خلال الموسم الزراعي 2009 باستعمال اصص بلاستيكية ذات سعة 2 كغم تربة. هدف التجربة هي دراسة تاثير مستويات مختلفة من سماد كمصدر للفسفور فوسفات الامونيوم الثنائية وتراكيز متزايدة من الجبرلين في محتوى عناصر النتروجين، الفسفور، البوتاسيوم، الكالسيوم والنسبة المئوية للكربوهيدرات الذائبة للجزء الخضري لنبات العدس صنف بركة.

شملت معاملات التجربة ثلاث مستويات من السماد (0.32, 0.16, 0) غم/اصيص والتي تعادل (80, 40, 0) كغم/ دونم على التوالي، وثلاثة تراكيز من الجبرلين (100, 50, 0) جزء من المليون والتداخل بين العاملين بموجب تجربة عاملية ذات التصميم العشوائي الكامل