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RESEARCH ARTICLE

Adding Boron to soil and its effect on quality and quantity of broad beans (*Vica faba*)

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Abstract

In field experiment for two seasons (2013-2014)planted broad beans in pots, to investigate the effect of Boron on the characters of two type of broad beans (spanish &local verity),the experiment was carried out in field of Baghdad university in Jadriah ,used mixture soil sandy ,in the experiment borax solution was used for borax in two level of treatment 5, 10 mg/kg, the result indicated that, the lowest dose of boron application effected the uptake of macro and micro nutrient also the result obtained the role of boron on quality of seeds, by measuring the number of seeds which increased by spanish varity 1.39%and local varity 1.51% and seed/plant 1.46% for the first varity and1.45% for the second varity,& Weight 100 seed g increase 1.12% the highest dose of boron decrease the percentage of protien .the low dose of boron help to release micro nutrient from the soil especialy the cupper, while high dose of boron didnt,and toxic for plant.

INTRODUCTION

Vica faba called (faba bean) Vicia faba L is well known from Fabaceae family , it was introduced in to agriculture in the late Neolithic period (Korber-Grohne,1987), (Cubero1974) concluded that the center of origin was in the near East ,Iraq and Iran, before 1000 BC the culture of faba was very established in Europe ,especially in Britain but it developed in Iraq only 1000-12000 years ago in East Iraq . The worldwide production in 2005 was about 5.8 million tons. the feeding value of faba bean is high with about 30% protein the most important crops for the human consumption in the middle East ,they considered it as a meat extender,(wolfgang Link et al 2009) showed, that feed and its effect for animals.

Important of the plant :

this plant has a special roots beans the typical nodules formed by Rhizobium leguminosarum (Tian,F.C, et al 2008) which was revealed rhizobia isolated from nodules of V. faba were differ in their chromosomal and plasmid content (Mutch & Young 2004),in addition Faba bean play a critical role in some agricultural system due to the ability of nitrogen fixing bacteria (atmospheric nitrogen which a used to prevent erosion also indirectly associated diversity of wild flora and fauna as well as soil microbes (Kopka and Nemecek 2010), the high contain of protein26g/100g and carbohydrate58 g/100g (mature seed row give energy) beside the minerals and vitamin and fibers ,its important because the role of Nitrogen fixation(Carmen 2005) . In spite of the important of this product, agriculture authorities to plant it considered that was not enough attention spent due to the fertilizing, plant nutrition and the cost. So this plant give superior yield of soil building carbon (biomass) and fix nitrogen .the strong root system aerates the soil and bring up deeply seated minerals and nutrient. The dry seeds contain 25% protein ,1.5% fat and 49% carbohydrate the young beans contain around 80% water but significant levels of carotenes and Vitamin C. The interaction between boron with other elements especially with Nitrogen is very important for rhyzobium.

The name broad bean is used for the large cultivars grown for human food while a smaller harder seeds used for animal food, faba bean is one of the most important legume crops in the Mediterranean Basin (Anonymous 1997) it

is known to an efficient nitrogen fixer about 80% from the atmosphere (Huber et al 1987) it has an essential place in regard to multipurpose of their usage in human diet or in animal feeding (Köpke & Nemecek 2010), the use of alternative plant protein In place of soybean ,faba appears interesting to use for dairy cow diet, the milk urea content was slightly lower in the faba group (Luisa A,V. et al 2010).Broad bean a good food to people suffer from Parkinson's diseases because of high plasma L-DOPA value have implication for treatment of Parkinson's disease especially with mild symptoms.(Rebey 1993) , Kempster ,P.A et al (1993). The negative point is , In some types of beans, an enzyme deficiency G6PD, the bode is exposed to any oxidizing substance so, can break the blood platelets and show decomposition of red blood cells and caused the anemia (Herman&Chaudhry 2014)

Important of Boron to plant:

B is an important micronutrient not only for human life but also for animals and plants. The essential nature role of B mentioned by French scientist in 1914, Boron was discovered by Sir Humphrey Davy Joseph-Louis Gay -lussac, L.J.at 1808 in England and France. (Ankush 1989). The origin name from the Arabic word buraq , boron compound have been known for thousands of years ,but the element was not isolated until 1808 (Bentor,Yinon).but a few of articles pointed to the needing of boron in plant growth and resistance (Sauchelli 1969). The numerous numbers of papers published on B role there is a lack in the knowledge concerns its effect on the quality of different crops (Stoyanov1985).

The biochemical role of B still understood, the evidence given by scientists showed that it is essential for plant growth and important in cell division (Cohen- Lepper1977), The plants grown in B deficient or B toxic soils is poor quality compared with that of plants grown in B-sufficient soils this reveal the effectiveness of B in the Biological regulation which involves enzyme and hormone systems (De La Haba,1985).

B plays an important role in the transport of nutrient elements across cell membranes, some investigations showed that B content in leaves margin was five times more than leaves lamina (Alt ,D-Schwarz 1973), (Ayad 2011) mentioned in two field experiments soil study the response growth , yield and quality of sunflower genotypes to boron levels application, Results showed that the genotype gave a high meaning values of leaf area , head diameter , number of seeds / head , 1000 seed weight , seed yield and oil yield , a high value of seed oil percentage , beside increased seed protein percentage and protein yield. an application foliar of boron were used to study the local rice response, there is an increasing in sterility with boron foliar through studying of some vegetative and reproductive growth characters (Akram, et al 2011) (Al-Sultan, H. et al 2010), Boron applied increased plant height and number of symposia branch per plant and increased fiber length in cotton (Hameed ,M Rajaa 2009) in white mustard. Results showed that higher concentration of boron was superior in seed yield and higher branches and higher plants (Al-Hilfy , H.I 2012), the development of B-esters group in carbohydrate system has a great importance in the improvement of the stable structure of cell walls (Mengle 1969). In Vigna radita . L**,** the experiment showed that, application of boron caused significant increase in plant height , seeds, yield than control (without B). An experiment on Vicia faba (two levels of Boron spray and without spray), could be summarized as follow: spraying B led to increase the concentration of N, P, K and Na in the leaves , while it had no significant effect on N and P in leaf concentration (Obaud 2013).

Material and Methods:

In field experiment for two seasons (2013-2014) in pots, planted to investigate the effect of Boron on the characters of two type of broad beans (Spanish &local verity),the experiment was carried out in field of Baghdad university in Jadriyah ,used a mixture(clay sandy soil), in the experiment borax solution was used for boron in two level of 5&10 mg/kg with three treatments, each treatment had 25 containers , the same environmental conditions for all treatment, all treatments received the same irrigation. Plant samples were taken at the same time of the year, seeds were taken at full ripeness. After collection the samples, the process to dry it, to determined and analyzed for quality parameters and macro- micro nutrients determinations of total N,P,K by the method of Mahr-pungor (1977) and Zsoldos(1977).the other macro and micro nutrient by ICP .

Statistical Analysis:

The Statistical Analysis System- SAS (2012) was used to effect of different factors in study parameters. Least significant difference –LSD test was used to significant compare between means in this study.

Results and Discussion:

The chemical analysis are presented in (table 1&2 and figures 1&2), showed the concentration of macro nutrient and its relation with B addition, Generally the nitrogen content in leaves in all treatment, higher than other parts and also in roots higher than the stems, however the treatment with Boron, showed that the elements move slightly but still higher in leaves. It is agreed with (Al-Shaibani 2009), that no effect on P and K movement in the treatment of lower concentration of boron. Leaner increasing up take by the different part of plant (fig 2,3) .the different value between fig. 2 and fig 3 , it is higher in fig. 3 than it in fig. 2 especially with K as it is depends on the type of broad beans. The content of higher value of elements depend on the type of broad bean but also on the influence of Boron (5-10 mg/kg) which gave a good result, this result agreed with (Jasim & Obaid 2013) .

Table 1: (N, P,K) content in different part of plant .

	Spanish	**Plant parts**	N%	P%	K%
1	**B0**	**Root**	2.17	0.355	2.61
2	**B0**	**Steam**	2.04	0.228	2.47
3	**B0**	**Leave**	4.14	0.305	2.31
4	**B1**	**Root**	2.43	0.312	1.61
5	**B1**	**Steam**	1.71	0.173	2.03
6	**B1**	**Leave**	3.92	0.277	2.13
7	**B2**	**Root**	2.39	0.284	1.64
8	**B2**	**Steam**	2.02	0.168	2.11
9	**B2**	**Leave**	4.09	0.319	1.75
LSD value	*(P<0.05).	-----	1,093*	0.044*	0.482*

Table 2: (N, P,K) content in different part of plant

	local	**Plant parts**	**N%**	**P%**	**K%**
10	**B0**	**Root**	1.35	0.063	0.701
11	**B0**	**steam**	0.786	0.019	0.511
12	**B0**	**leave**	4.89	0.207	0.632
13	**B1**	**Root**	1.25	0.07	0.667
14	**B1**	**steam**	0.714	0.023	0.926
15	**B1**	**leave**	4.47	0.298	0.71
16	**B2**	**Root**	1.29	0.074	0.623
17	**B2**	**steam**	0.429	0.025	0.338
18	**B2**	**leave**	4.43	0.288	0.805
LSD value	*(P<0.05).	------	1.075*	0.016*	0.228*

Fig. 1: (N, P,K) content in different part of Spanish peas

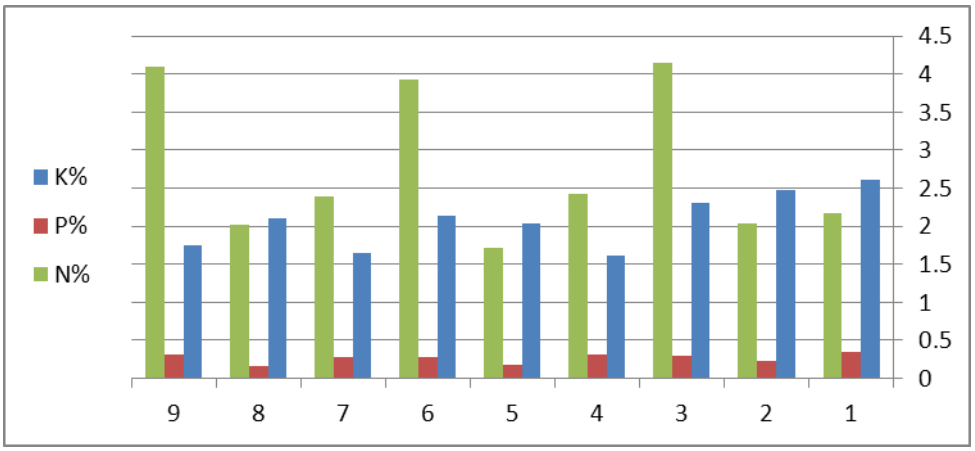


Fig. 2: (N, P,K) content in different plant part of Spanish peas

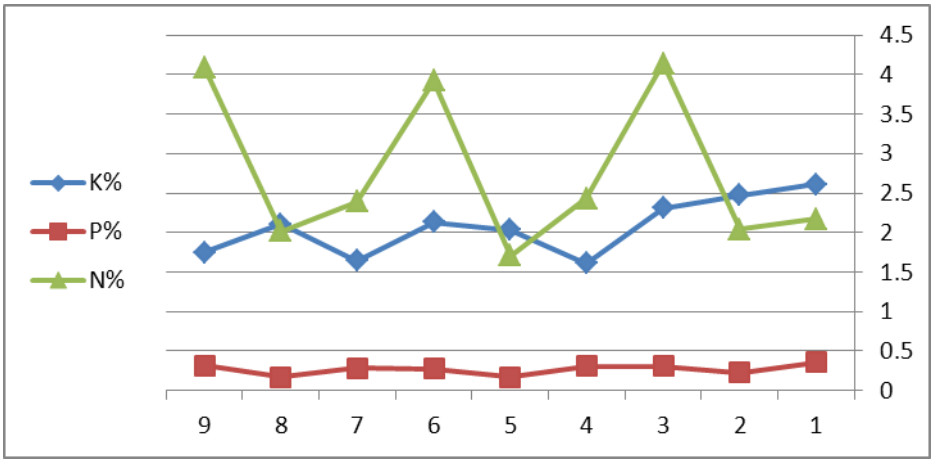
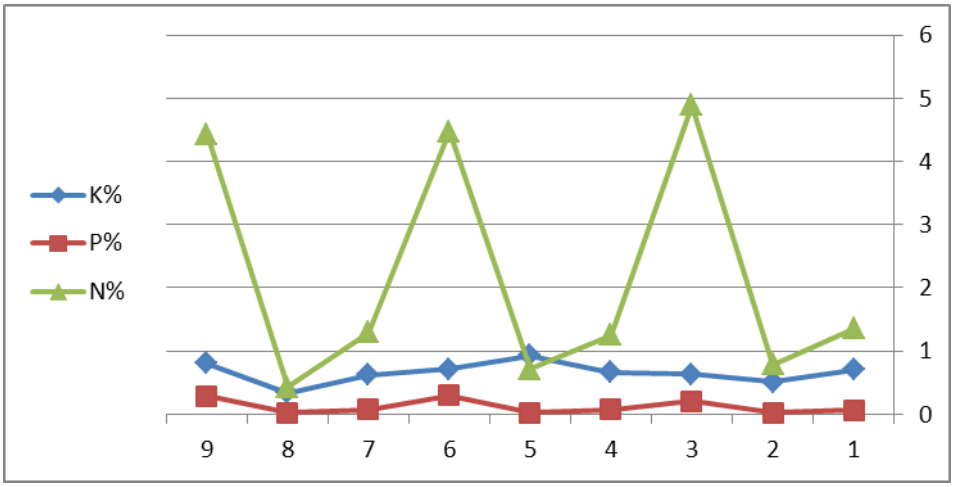


Fig. 3: (N, P,K) content in different plant part of local peas



Analyzing the result in (table3,4 and fig. 4,5,6) one can see that, increasing the Mg content with B apply, result appeared in the fig 4 ,show No1 the **root** of the treatment without boron and No4 the treatment with the lowest concentration of boron and 7 the high concentration of boron ,but the is no significant in stem, but in laves the lowest concentration of boron show the best result ,no increasing by more addition of boron ,the **Ca** content show the same result and similar to Mg in stem by all the treatment, but in root there is slightly increasing with boron concentration ,but leaves give the best result by 5mg/kg in Ca content which is necessary to plant building B which help to regular the metabolism(Davis et al 2003).In fig.5,6 the different between the two kind of the plant and see the higher content of Ca especially in the roots of plants, Boron led to a significant increase in leaves concentration of K, Ca, this result may be caused by and increase the Ca content in cell wall (jasim & Obaid 2013).

Table 3: (Ca,Mg%) content in different part of Vica faba(spanish)

	Vica faba(Spanish)	Plant parts	Ca%	Mg%
1	B0	Root	0.595	0.118
2	B0	steam	0.495	0.114
3	B0	leave	0.855	0.171
4	B1	Root	0.674	0.158
5	B1	steam	0.496	0.125
6	B1	leave	0.777	0.196
7	B2	Root	0.835	0.193
8	B2	steam	0.508	0.14
9	B2	leave	0.88	0.186
	LSD value*(P<0.05).	-----	0.215 *	0.0553 *

Table4: (Ca,Mg%) content in different part of plant Vica faba(local)

	Vica faba(local)	Plant parts	Ca%	Mg%
10	B0	Root	1.42	0.318
11	B0	steam	0.558	0.128
12	B0	leave	0.285	0.095
13	B1	Root	1.75	0.336
14	B1	steam	0.562	0.142
15	B1	leave	0.26	0.086
16	B2	Root	1.57	0.26
17	B2	steam	0.45	0.143
18	B2	leave	0.252	0.096
	LSD value*(P<0.05).	----	----	----

Fig. 4: (Ca,Mg%) content in different plant part of Vica faba(local)

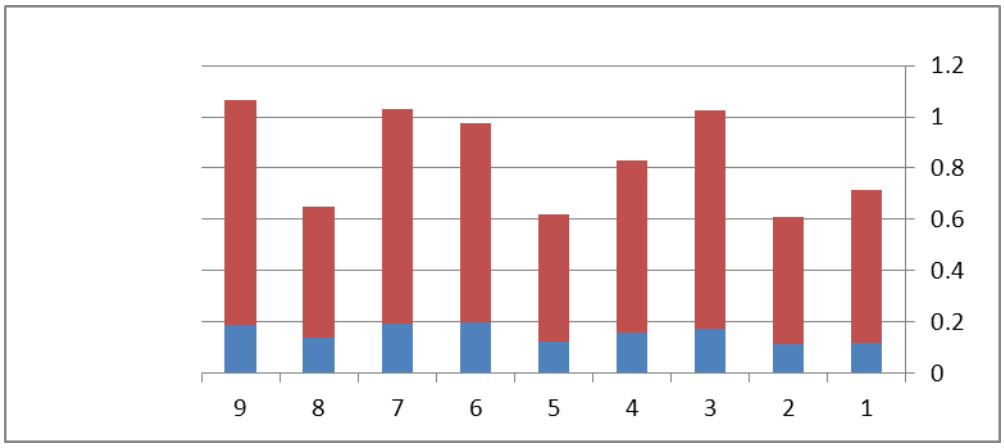


Fig. 5: (Ca,Mg%) content in different plant part of Vica faba(Spanish)

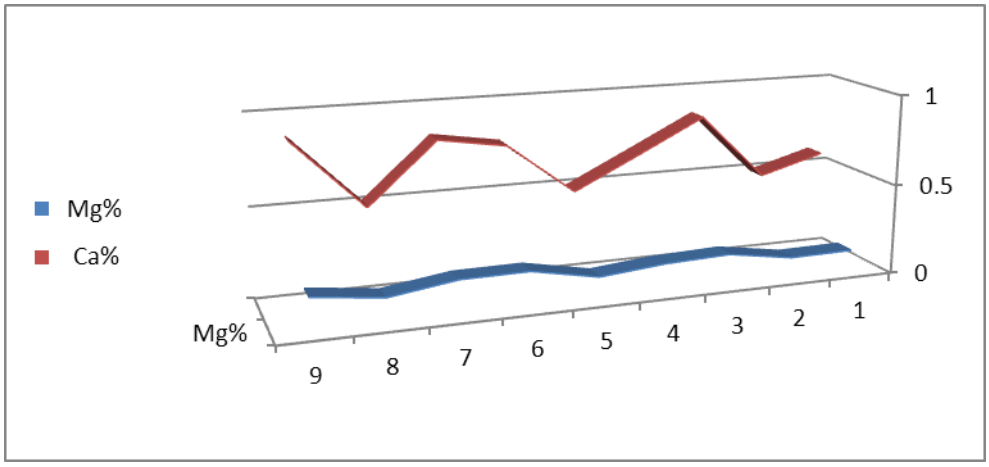
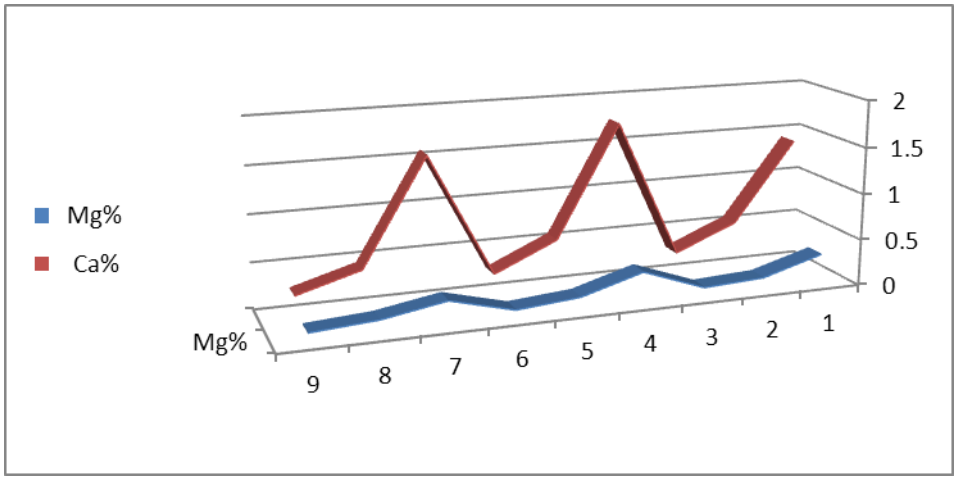


Fig. 6 : (Ca,Mg%) content in different part of plant Vica faba(local)



The relation between B and micro nutrient: The relation between B and other micro nutrient has shown in fig (7,8,9) depend upon the type of plant and it is clear to see the local verity is higher in micro nutrient than the Spanish one, the distribution of elements in different than the local verity, generally all the elements higher in leaves than the other part of plant, due to the effect of boron on the distribution of elements in different parts of the plants and the role of boron in the absorption elements and concentrate in leaves than the other parts of plant so, there is a risk in the consumption of leafy crops, there is no effect on Cu even with high concentration of B ,but in the other type of plant the is slightly effect on the roots because of the boron and its role to increase the uptake from the soil, the effect of B on Mn and Zn is very clear on the different part of the plant ,especially in local type, the distribution of boron in the local verity is different than the Spanish one, with the addition of B in the high concentration, the other elements also high ,it seems a positive correlation between them, in fig. 8 the effect of B caused a high up take of Mn and Zn more than B concentration ,this is due to role and the influence of boron in the integrity of cell membrane to increase the absorption ,the result is agreed with (Rodriguez-Harnandez et al 2013).

Table 5: micro nutrient content in different part of plant mg/kg.

	faba(Spanis)	**Plant parts**	**Fe**	**Mn**	**Zn**	**Cu**	**B**
1	**B0**	**Root**	**810**	**38,4**	**29,4**	**19,5**	**34,6**
2	**B0**	**steam**	**20,3**	**7,14**	**16,5**	**6,32**	**19,2**
3	**B0**	**leave**	**226**	**23,7**	**39,1**	**10,9**	**57,7**
4	**B1**	**Root**	**462**	**15,2**	**15,8**	**8,62**	**26,9**
5	**B1**	**steam**	**58,1**	**6,25**	**13,3**	**4,02**	**23,1**
6	**B1**	**leave**	**163**	**30,8**	**39,3**	**9,20**	**115**
7	**B2**	**Root**	**299**	**13,0**	**18,4**	**6,90**	**21,2**
8	**B2**	**steam**	**29,7**	**7,59**	**19,2**	**4,60**	**15,4**
9	**B2**	**leave**	**477**	**29,9**	**41,0**	**8,91**	**73,1**
* (P<0.05).	**LSD value**	-----	**61.46 ***	**7.53 ***	**6.94 ***	**3.25 ***	**9.63 ***
10	**B0** faba(local)	**Root**	**333**	**48.7**	**22.3**	**5.17**	**17.3**
11	**B0**	**steam**	**31.1**	**9.82**	**5.82**	**0**	**15.1**
12	**B0**	**leave**	**24.3**	**57.6**	**37.4**	**2.3**	**21.1**
13	**B1**	**Root**	**1230**	**46.4**	**44.9**	**10.3**	**30.8**
14	**B1**	**steam**	**60.8**	**15.2**	**10.4**	**2.59**	**23.1**
15	**B1**	**leave**	**24.3**	**46.4**	**38.1**	**3.45**	**25**
16	**B2**	**Root**	**680**	**31.7**	**34.2**	**8.04**	**28.8**
17	**B2**	**steam**	**32.4**	**5.36**	**16.7**	**0**	**19.4**
18	**B2**	**leave**	**18.9**	**67.4**	**67.2**	**4.88**	**24.9**
* (P<0.05).	**LSD value**	-----	**14.68 ***	**9.71 ***	**9.06 ***	**4.17 ***	**6.74 ***

Fig 7: micro nutrient content in different part of faba (Spanish)

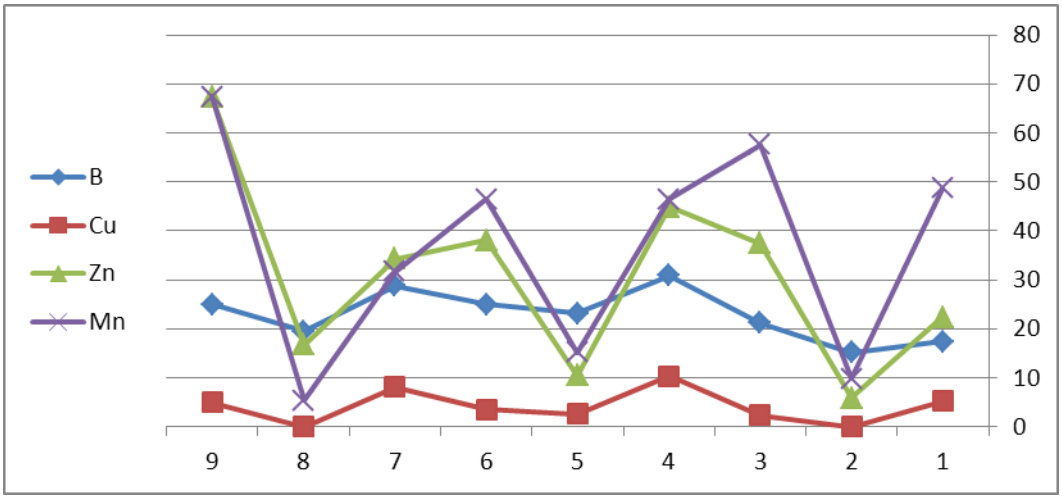


Fig. 8: micro nutrient content in different part of faba (local)

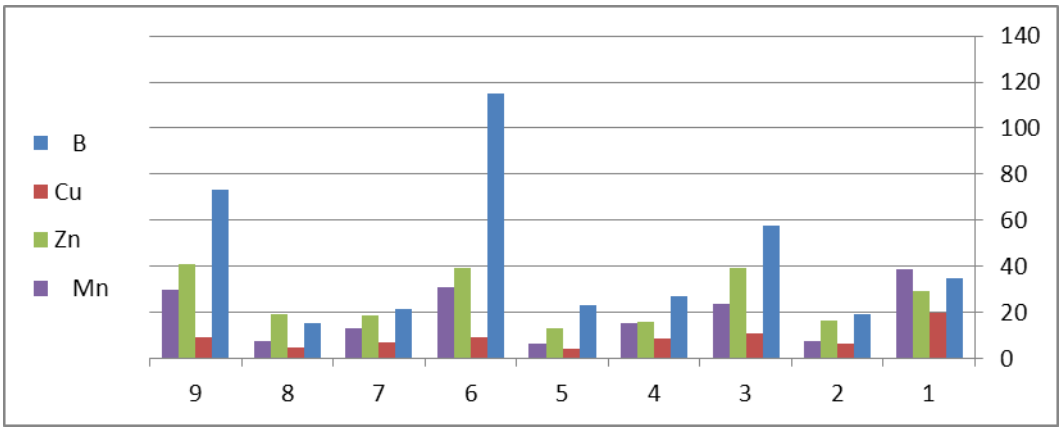
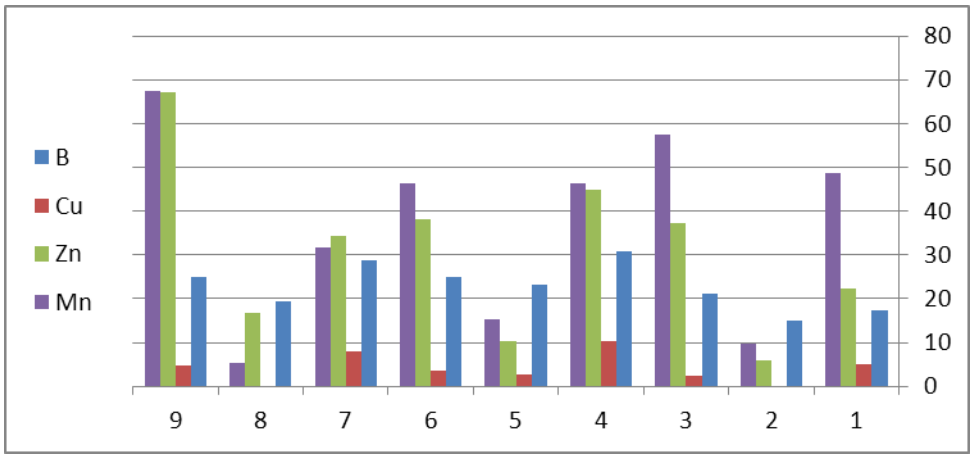


Fig. 9: micro nutrient content in different part of faba (Spanish)



Seeds content of nutrients:

the effect of B application are presented in (table 6 & fig 10) show, the seeds contain of N, which it seems higher percentage than the other macro nutrient, but the N percentage is decrease by increasing B in compared with N content in the other part of plant , because of the role of nitrogen and it's important to build protein and amino acids. The result explains that the high dose of B is not favorable dose for the plant, , as for phosphorus and Magnesium, there is no effect by addition of boron, as there is a positive relation between the plant content of K with B ,also the K is well known by the luxury uptake .

The Ca concentration in the seeds effected by the uptake of Ca by the plant , the above result confirms the fact that the relation between B and Ca is positive in the lower rate of B, but however is decreased when using the high dose of boron which not in favor for the plant.

The effect on the movement of micro nutrient by adding boron, shows in the table No:7

The treatment with high B dose gives no significant effect on Cu and Zn uptake, but a small amount of boron which will increase Cu and Zn value in the seeds. The result of Mn (table:7) proves the positive relation with low concentration of B, but when the B concentration increased, then Mn will decrease under the half rate. The positive and parallel correlation between Fe and B which presented in table 7.

Table 6:(seeds content of macro elements)

seed s	**N%**	**P%**	**K%**	**Ca%**	Mg%
seed B 0	2.50	0.042	1.24	0.517	0.124
seed B 1	2.25	0.046	1.32	0.603	0.136
seed B 2	0.607	0.032	1.46	0.385	0.102
LSD value* (P<0.05).	0.584 *	0.218 NS	0.339 NS	0.184 *	0.066 NS

Table 7 :(seeds content of micro elements mg/kg)

seeds	**Fe**	**Mn**	**Zn**	**Cu**	**B**
Seeds B 0	**19.5**	**79**	**17.7**	**0**	**69.2**
seeds B 1	**56.8**	**135**	**29.9**	**2.01**	**108**
seeds B 2	**23**	**51.3**	**30.8**	**0**	**96.2**
LSDvalue*(P<0.05).	**8.54 ***	**13.69 ***	**6.74 ***	**0.672 ***	**21.94 ***

Fig.10: (seeds content of macro elements from the bottom up B0,B1,B2)

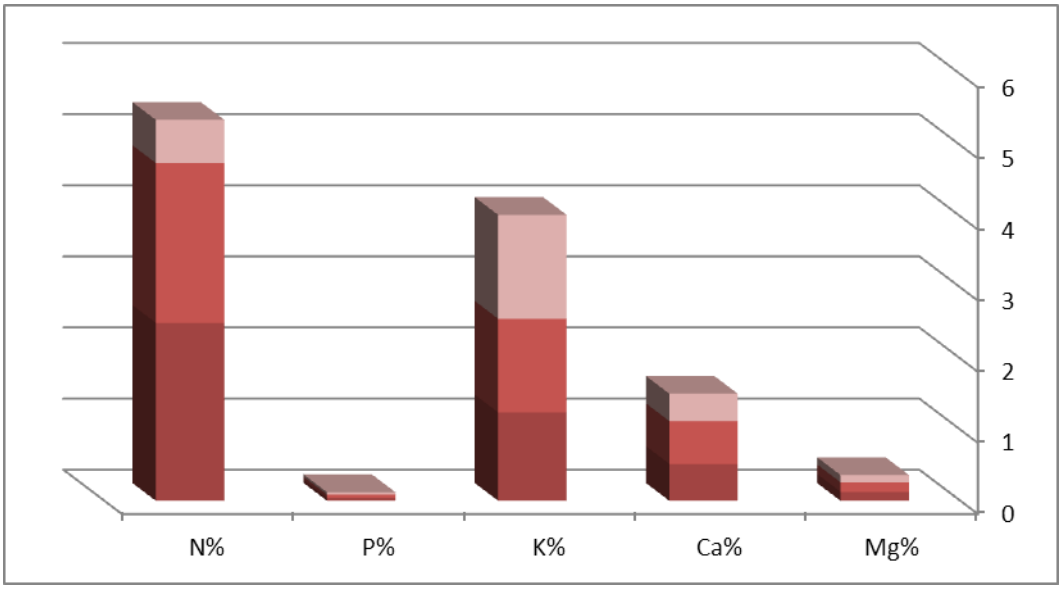
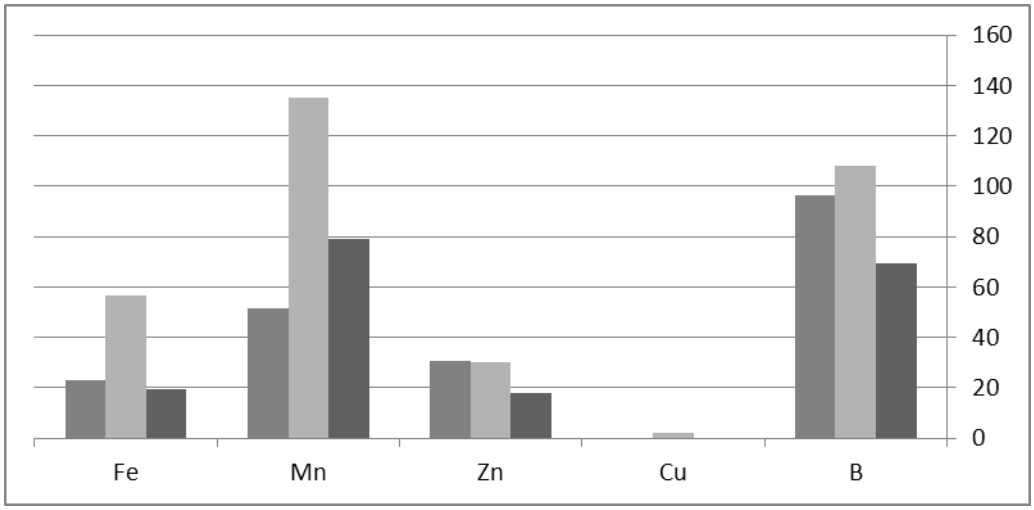


Fig.11: (seeds content of micro elements from right to left B0,B1,B2)



The effect of B application are presented in (table 6 & fig 10) show, the seeds contain of N, which it seems higher percentage than the other macro nutrient, but the N percentage is decreased by increasing B in compared with N content in the other part of plant. Because of the role of nitrogen which it's important to build protein and amino acids, this result explains that the high dose of B is not favorable dose for the plant, , as for phosphorus and Magnesium, there is no effect by adding boron, but there is a positive relation between the plant content of K with B ,also K is well known by luxury uptake.

The Ca contain in the seeds effected by the uptake of Ca by the plant , the above result confirm the fact that the relations between B and Ca is positive in the lower rate of B but the result is decrease when using the high dose of boron which no the best for the plant ,

The treatment with high B gives the same result like treatment without it but small amount of boron caused Cu uptake, the seeds content of Zn effected by boron application but there is no significant result by more B.the result of Mn is very clear and proved the positive relation with low concentration of B, but when the B concentration increase, the Mn decrease under the half value the Fe similar to B concentration. In conclusion the lowest dose ie the best for the plant.

The effect of B treatment on the yield:

Table No: 8 show the effect of different treatment on two type of beans it is well known fact that under both deficiency and toxicity conditions of any essential microelements ,the yield of the crops is considerably reduce when compared with that the sufficient amount of micro elements to the plant (Ankush 1989) . The result shows that the treatment 5mg/kg is the best to give a better result in quantity and quality of yield, which prove the role in flowering and fruiting.

The data clearly explains the correlation between rate of B and broad beans yield.

Table8: (The quantity and quality of peas plant seeds)

treatment	No of pod/plant	No of seed/ pod	Seed/plant	Weight 100 seed g
B0 Spanish	6.88	4.923	34.46	144.32
B1	9.54	5.876	50.32	160.54
B2	6.32	4.342	30.76	140.21
B0 local	7.12	5.013	36.91	147.35
B1	10.77	5.911	53.44	164.78
B2	6.84	4.221	28.36	145.94
LSD value* (P<0.05).	2.17 *	2.08 NS	9.64 *	16.58 *

Table 9 (Nitrogen and Protein content of peas seeds)

	treatment	N%	Protein%
1	B0	2.50	15.63
2	B1	2.25	14.06
3	B2	0.607	6.70
4	B0	2.37	14.82
5	B1	2.45	15.31
6	B2	0.543	5.76
	LSD value*(P<0.05).	----	4.87*

(Table :10 Relation Ca & B in Plant part of Vica faba local)

	Vica faba1	Plant part	Ca %	B mg/kg
1	B0	Root	0.595	34.6
2	B0	Steam	0.495	19.2
3	B0	Leaves	0.855	57.7
4	B1	Root	0.674	26.9
5	B1	Steam	0.496	23.1
6	B1	Leaves	0.777	115
7	B2	Root	0.835	21.2
8	B2	Steam	0.508	15.4
9	B2	Leaves	0.880	73.1
---	LSD value P<0.05).	---	0.271 *	16.85 *

References:

- Abd Elaziz,M.(2006): Effect of Boron and method of addition on the growth and chemical composition of plant and seeds content of peanuts Minia J. of Agric. Res. & Develop. Vol.(26) No.4 pp 765 -780
- ABDULMAJID ALSHAIBANI, ZAHIRA YAAKOB and ABDUL JALIL GHALEB (2009): hydrogenation process using Pd-B/γ-Al2O3 catalyst to study the effect of the process factors, including ...

(RSM) is astatistical method for experimental ... Pd-B/³-Al2O3catalyst prepared using wet . Appl. Catal., A. 366 (1): 154-159 25

- Ahmed,M.A.&H.M.H.El-Abagy, (2007): Effect of bio-and mineral Phosphorus fertilizer on the growth, productivity and nutritional value of some faba bean(Vica faba L)cultivars in newly cultivated land.Jour.of Appl.Sci.Res 3(6):408-420.
- Akram O. Esmail. Ghafoor A. Mam Rasul and Aram A. Mohammed (2011): Local rice Cultivar to Zinc and Boron application. Journal Of Baghdad Science Vol (8) 2 pp:289-294
- Al-Hilfy ,I.H. (2012): Effect Of Boron and Potassium spraying On Growth and Yield of White Mustard . . The Iraqi Journal Of Agricultural Science Vol 43.(2) pp:56-64
- Al-Sultan ,H. Ragheed. Al- Alaf ,H.Ayad .and Dawood ,A. Zuhair.(2010): Effect Of Foliar Application Of Boron On Growth ,Flowering and Yield Of Strawberry. The Iraqi Journal Of Agricultural Science Vol 41.(3) pp:89-98.
- Alt ,D .Schwarz , W (1973): Bor Toxizitat Bor Aufnahme und Bor-Verteilung bie jungen Gurken Pflanzen under dem Einfluss der N- form Plant soil 39. 277-283
- Ankush,j.A (1989): Dynamics of Nitrogen in Soil-Plant system in connection with Boron supply , Thesis of PhD
- Anonymous, (1997):Food and Agriculture Organization of United Nation

(FAO).Production Year Book, FAO ,Rome,Italy.

- Carmen, M. A,Z.J . Carmen ,S. Salvador, N. Diego, R.M.Maria Teresa and T.Maria (2005): Detection for agronomic traits in faba bean (Vicia faba L) Agric.Conspectus Sci ,70 (3) : 17-20
- Chang Fu Tian, En Tao Wang, Li Juan Wu, Tian Xu Han, Wen Feng Chen ,Chun Tao Gu, Jin Gang Gu, and Wen Xin Chen ,(2008): Rhizobium,fabae Sp.nov., bacterium that nodulates Vicia Faba. International Journal of systematic and Evolutionary Microbiology .Vol 58,no 12 pp:2871-2875.
- Cubero,J.I. (1974): On evolution of Vicia Faba L. Theoretical and Applied Genetics 45, pp:47-51.
- Fadhel H.M, (2011): Effect of potassium fertilizer and boron foliar on Vigna radita.L,Diyala Agricultural Sciences Journal Vol (3) 1 pp: 107-117.
- Hameed , M. Rajaa(2009): Some Growth Characters and Qualitative. Al- Anbar Journal Of Agricultural Science Vol 7 (2) pp:29- 38
- Herman Michael & Sultan Chaudhry (2014):Thalassmia Mc Master Pathophysiology Review 2012-2014
- Huber,R., E.R.Keller and F. Schwendimann,(1987): Effects of Biological Nitrogen Fixation by Faba Beans (Vicia Faba L)on the Nitrogen Economy of the soil .Fabis News 1 17: 14-20
- Kempster P A,Bogetic Z.,Secombei J W.,Martin HD.,Balazs NDH,and Wahlqvist ML (1993): Motor effects of Broad beans (Vicia Faba)in Parkinson's disease :single dose studies.Asia Pacific,j Clin Nutr. 2.PP: 85-89.
- kopka,U. and Nemecek, T (2010): Ecological services of faba bean. Field Crops Resaerch Vol.115 pp:217-233.
- Körber-Grohne,U. (1987) Nutzpflanzen in Deutschland Kulturgeschichte undBiologie.Thesis,Stuttgart (Crop Plants in Germany: History of Cultivation and Biology).

- Luisa Antonella Volpelli ,Michele Comellini , Francesco Masoero ,Maurizio Moschini, Domenico Poetro Lo Fiego Rossana Scipion (2010): Faba Beans (Vicia Faba) in dairy cow diet ,effect on milk production and quality .Italian Journalof Animal Science Vol 9 No:1 e 27

- Mengel, K. (1986):Ernahrung und Stoffwechsel der Pflanze .Gustav Fischer,Jena.

- Mutch,L. A. & J.P.W. Young 2004). Diversity and specivicity of Rhizobioum leguminosarum. Biovar Viciae on wild and cultivated legumes. Mol. Ecol. 13:2435-2444.

- Obaid , A. H.J .A.S.Sadiq (2013): Effect of some foliar fertilizers spray and its interaction with boron on broad bean (Vicia faba L.)leaf content in the certain nutrient .Euphrates Journal Of Agriculture Science ,Vol (5) 4 PP: 56-63

- Rabey JM, Vered Y ,Shabtai H, Graff E, Harsat A, Korczyn AD. (1993): Broad Bean(Vicia faba) consumption and Parkinson' s disease Adv Neurol 60 :68 pp:1-4.

- Rodriguez-Harnandez,M.C.D.A Moreno,M Carvajal and M.C.Ballesta (2013) Interactive effect of boron and Nacl stress on water and nutrient transport in two broccoli cultivars.Functional Plant Biol 40 (7):739-748.

- SAS. 2012. Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

- Sauchelli,V .(1969): Trace Elements in Agriculture.Van Nostrand Reinhold Company ,New york. Cincinnati, Toronto,London, Melbourne PP: 81-106

- Stoyanov ,D.(1985): Boron Fertilization Pochvozn, Agrokhim,Postit Zashch 20 Vol .XX No:1.p82-88 printed by Borax HoldingsLimited,Borax house (translation of Bulgarian papar.)

- wolfgang Link,Moemen Hanafy, Nenad Malenica ,Hans-jörg jacobson and Srecko Jelenic(2009): Faba Bean - Compendium of Transgenic Crop Plants... Blackwell Publishing Ltd.