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Potassium Fertilization in Conjuction with Foliar Applied Molybdenum and Humic Substances for Faba Bean

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ABSTRACT

Two field expereriments were carried out on sandy soil at a private farm, at El-Shaarawey Village, El Bustan Region, El Behira Governorate located at lat. 30° 43' 22.01"N, long. 30° 13' 44.50" E. during two consecutive seasons at 2012/2013 and 2013/2014.The study was to assess the influence of appling K as soil addition alone or in combination with K foliar application and foliar applied humic substances (HS) at two rates (1 and 2 g/L) in absence or presence of foliar applied molybdenum (6 ppm) on the yield productivity of faba bean plants (C.V Nubaria 1). The results could be summarized in the following points:Data inferred that molybdenum had a significant promotive effect on weight of pods/plant, 100-seed weight, straw, pod and seed yields. Also, the data indicated that content of N%, K% and their uptake , as well as protein% were significantly increased due to foliar application of molybdenum .Soil application of the half recommended rate(HR) of K with foliar spray of HS (1 or 2 g/L) or 1% potassium sulphate, irrespective of molybdenum treatments, gave the most positive effect on yield, its components, and uptake of N,P and K in seeds compared to sole application of full or half recommended rate with no significant differences in most cases.The highest pod or seed yield as well as weight of pods/plant were achieved by application of 50%-K along with foliar HS (1g/L) while, the highest 100-seed and straw yield were recorded by using HS (2g/L). The interaction effect on the studied characters notably appeared in the triple treatment of K-50% as soil addition with foliar application of humic substances at rate (1g/L) and molybdenum (6 ppm) which was superior to others and achieved the significant effect on 100-seed weight, straw yield, N%, P% ,K% and protein %, as well as N, P and K uptake.

INTRODUCTION

Faba bean (*Vicia Faba*) is nutritionally an important vegetable crop all over the world, containing 20-36% protein for human and animal consumption. In Egypt, faba bean is considered the principal winter leguminous crop used as a source of protein. In addition, faba bean plants improve soil fertility by providing a substantial input of N fixation.

The sandy soil texture is properties with much reduced organic matter, low water holding capacity and high nutrient losses by leaching, and these tend to decreased of macro and micro-nutrient in arid and semiarid regions. In addition unbalanced programs of mineral fertilization depend on the application of huge amounts of N, P and reduced amount of K-mineral fertilizers, to meet the nutritional needs of heavy agriculture policy that used high yielding new crop varieties. As well as, decrease of organic matter content in soil. Potassium is the play important cation not only in regard to its content in plant tissues but also with respect to its physiological functions. K has positive effect on the water relationships in plants, regulating such aspect as the osmotic pressure cell turgor and the functioning of the stomata apparatus. It also improves the N management and plant immunity to the biotic stress (Cakmak, 2005).

Potassium fixation in soil clay minerals and the greater demand for potassium by modern high yielding cultivars are also the causes of potassium deficiency in soils (Oosterhuis, 1998). This situation has been further aggravated by rising prices of potassium fertilizers. Potassium deficiency at the initial stage of plant development significantly disturbs the distribution of assimilates between the aboveground organs and roots (Marschner, *et al*.1996) and it has negative effect on the processes of atmospheric N_2 fixation (Lifang ,*et al*.2000 and Mona, *et al*., 2011).

Investigation efforts have been concentrated to improve the fertilizer use efficiency by employing various techniques including foliar fertilization. Roemheld and El-Fouly (1999) indicatied that nutrient uptake by roots can be a limiting factor to achieve adequate growth and optimal yield. This can be the case during critical periods of plant development or during environment conditions. Under these conditions, foliar application is advantageous; Oosterhuis (1998) reported that foliar application of a nutrient might actually promote the root absorption of the same nutrient.

Molybdenum is a trace element found in the soil and is required for growth of most biological organisms including plants and animals. The availability of molybdenum for plant growth is strongly dependent on the soil pH, concentration of adsorbing oxides (e.g. Fe oxides), extent of water drainage, and organic compounds found in the soil (Reddy *et al.*, 1997).

Humic acid, as a commercial product contains 44-53% C, 42-46% O, 6-8% H and 0.5-4% N, as well as many other elements (Larcher, 2003). Humic acid is improve soil fertility and increases the availability of nutrients by holding them on mineral surfaces. The humic substances are mostly used to remove or decrease the negative effects of chemical fertilizers from the soil and have a major effect on plant growth (Ghabbour and Davies, 2001). Humic substances lead to a greater uptake of nutrients into the plant root and through the cell membrane (Yilmaz, 2007). Foliar sprays of these substances also promoted growth, and increased yield and quality in a number of plant species (Yildirim,2007), improved growth, yield quality and significantly increase in the accumulation of P, K, Ca, Mg, Fe, Zn and Mn in tissues of plants as well as increased accumulation of N and Ca in roots (Erik *et al.*, 2000).

In the same respect, Unlu, *et al.* (2011) and Abdel-Razzak and El-Sharkawy (2013) showed superior effect for increasing vegetables productivity by spraying humic acid twice. In addition, Shehata,*et al*. (2012) reported that the highest scored plant growth, total yield and nutrient values of cucumber plants were recorded with 1.5 g/l humic acid compared with control.

The objective of this study essentially was to improve faba bean yield and quality, as well as, the possibility of reducing costs through reducing the soil potassium application in sandy soils by using foliar potassium as a supplementary application and humic substances with or without molybdenum.

MATERIALS AND METHODS

Two field experiments were carried out at a private farm at El-Shaarawey Village, El Bustan Region, El Behira Governorate located at lat. 30° 43' 22.01"N, long. 30° 13' 44.50" E. during two consecutive seasons 2012/2013 and 2013/2014 to study the response of broad bean plants to soil and foliar fertilization of potassium with humic substances in absence or presence of molybdenum .

A composite soil samples were taken from the experimental site before planting to determine some physical and chemical properties presented in Table (1) as outlined by Piper (1950) and Page *et al.* (1982**)**

Table(1) Some physical and chemical properties of the used soil

Course sand (%)	**Fine sand (%)**	**Silt (%)**	**Clay (%)**	**Texture**		**O.M (%)**		**$CaCO_3$ (%)**
6.48	83.36	6.23	3.93	Sandy		0.18		1.73
pH (1:2.5)	EC(dS/m) in soil paste ext.	Cations (meq/l)				Anions (meq/l)		
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO^{-}_{3}	Cl^{-}	SO^{--}_{4}
8.43	0.77	5.62	3.89	7.44	0.85	1.38	5.98	10.44
Macronutrients (mgkg^{-1} soil)								
N			P			K		Mo
36.95			3.49			85		0.1

The used experimental design was split-plot with three replicates. Plot area was 10.5 m^2 (3.0m X 3.5 m) with five lines. Faba bean seeds, Nubaria 1 cultivar, were sown at a rate of 80 kg fed^{-1} on 9th and 15th November for the first and second seasons,respectively. Mo-treatments (without and with Mo) occupied the main plots, while, potassium treatments represented the sub plots.

Faba bean plants received three sprays of 1% potassium sulphate solution (400L/fed) after 30, 45 and 60 days from sowing. Humic substances was foliar applied with two levels (1 and 2g/L) as K-humate(400L/fed) and it was conducted three times;the first one was after 20 days of planting date and then at 15 days intervals . The used humic substances composed from (85% humic acid, 5% N, 2.8% P , 12%K(K_2O) , fulvic acid 2%).

Each experiment included 10 treatments which were divided to two groups related to two molybdenum treatments occubying the main plot [with or without foliar application of molybdenum (6ppm) as ammonium molybdate three times 35,50 and 65 days after planting (400L/fed)] and the following five treatments distributed in sub plot:

1- Potassium sulphate(48%K_2O) as soil application at rate of 100kg fed^{-1} (full recommended rate:FR)
2- Potassium sulphate as soil application at half recommended rate HR (50% from FR)
3- Potassium sulphate as soil application at half recommended rate (HR) + 1% potassium sulphate as foliar spray.
4- HR + humic substances 1g/litre.
5- HR + humic substances 2g /litre.

The recommended K rate (100 Kg fed^{-1}) as potassium sulphate (48%K_2O) for faba bean plants in sandy soil was done after thinning. Organic fertilizer was added at the rate of 20 m^3 /fed before planting . The nitrogen fertilizer as ammonium sulphate(20.6% N) was added at rate of 20 kg N fed^{-1} during seedbed preparation as a stimulatory dose. A basal dose of calcium superphosphate (15P_2O_5) was added to each plot at the rate of 30 kg P_2O_5fed^{-1} before sowing.

Seeds were treated just before sowing with the local peat based legume inoculant “Okadin”. The other cultural practices were carried out according to the usual methods adopted for faba bean crop.

At harvest, faba bean yield parameters such as : No of pods/plant, pods dry weight/plant(g), 100- seed weight , seed yield (kg/fed.), pods and straw yield (kg/fed.) were recorded.

Seed samples from each treatment were taken for chemical analysis since they were digested using H_2SO_4 and $HClO_4$ acid mixture (1:1). The digest was then used to determine N, P and K concentration in faba bean seeds as described by Chapman and Pratt (1961). Crude protein content was also calculated by multiplying N% by 6.25. Yield data were statistically analyzed according to Snedecor and Cochran (1990)

RESULTS AND DISCUSSION

I-Faba bean yield:

The effect of treatments with potassium and humic substances in absence or presence of molybdenum on yield of faba bean and its components are presented in Table (2). Data indicated that using molybdenum as foliar application had a significant promotive effect on weight of pods/plant, 100- seed weight, straw, pod and seed yields but not No. of pods/plant. These results could be due to the a positive effect of Mo on nodule forming in legume crops, since Mo is an essential component of nitrate reeducates and nitrogen's which control the reduction of inorganic nitrate and helps in fixing N2.Thus, Mo is the key to N fixation by legumes. Also, Mo is required in the synthesis of ascorbic acid and is implicated in making Fe physiologically available within plant. So, all these factors increase dry matter accumulation. These results are in consistent with El-Beheidi *et al*.,(1995) who reported that foliar application of faba bean plants with Mo is important under sandy soil condition for increasing number and length of root . In this connection, Rizk (2003) reported that, Mo has positive effect on broad bean dry matter yield of straw and seeds which may be due to the stimulation of N by plants. In addition, molybdenum at rate 2.0 $gmkg^{-1}$ with seeds recorded the highest growth parameters for groundnut compared with control, (Niranjana *et al*., 2005). Also, Bhagiya *et al*.,(2005) showed that molybdenum foliar was significantly increased pods and seeds yield in chickpeas and groundnuts . Moreover, Ewa *et al*.(2004) reported that the foliar application of faba bean with Mo at the beginning of flower bud format resulted in a 3%increase in seed weight per plant and seed yield. Hala Kandil *et al.*,(2013) showed that foliar application of Mo markedly increased pod weight and 100- seed weight of common bean .

Regarding to the effect of K fertilization, data in Table(3) declared that the recommended level of K-fertilizer (100% FR) gave higher values for the seeds and pods yields and 100-seeds weight of faba bean than those of the HR. This may be due to that enough potassium nutrition increased yield and improved the quality of most crops by stimulating chlorophyll synthesis and sharing in many vital physiological processes in the plant (Moussa, 2000).

However, soil application of HR with foliar spray of 1% potassium sulphate, gave a positive effect on yield and its components compared with the full or the half recommended rate of K as soil application. This is probably due to that foliar spray technique provides the plants with required nutrients which may one or more of them were insufficiently supplied through the root system in such low soil fertile soils. The foliar application could be considered as the best way to reduce and maintain necessary fertility levels in plant root zone and consequently improve plant growth (Mohammed *et al*., 2010) .Also, these increase could be interpreted on the basis of the role of K in improving plant metabolism, enhamcing plant merstimatic activity and increasing photosynthesis rate (Mengel and kirkby, 2001).Foliar application of nutrients could improve the nutrients utilization and lower environmental pollution through reducing fertilizers added to soil(Abou-El-Nour,2002). Also, he found that applying 36kg K_2O supplemented with foliar potassium feeding gave the highest increase in 100- seed weight, number of pods and seed yield. The positive effect of soil application of K that supplemented with K foliar feeding on broad bean yield and its component could be due to the better K nutrition which improve pod setting and leads to stimulating the storage capacity for assimilates which in turn, induce remarkable increase in 100- seed weight and number of pods/plant.

In addition, foliar K may be a supplemental option when climatic and soil conditions reduce nutrient uptake from the soil (Yuncai *et al*., 2008). In this respect, Ahmad (1998) stated that spraying nutrients not only can increase the crop yields but also can reduce the quantities of fertilizer applied through soil. Furthermore, Nassar *et al*.(2005) suggested that faba bean plants significantly responded to foliar spraying with either P and K comparing with their soil application. In the same respect, El-Shikha *et al*., (2005) reported that, K-fertilization must be applied to sandy soil at the rate of 48 kg K_2O/fed. in sowing, during the vegetative and flowering growth stages to overcome the disturbance of nutritional balance in soil and for getting the highest productivity and the best quality of faba bean plants as well as attaining the best faba bean seed and straw yields in sandy soil.

On the other hand, as illustrated in Table (2), the obtained results indicate that the above yield parameters were stimulated by consecutive doses of humic substances with K-50% (HR) soil application and the highest values were recorded by adding K-50% soil application with 2g/L foliar spray of humic substances. The superiority of the highest levels of humic substances in enhancing plant growth may be attributed to its high contents of macro and micronutrients and presence of plant growth regulators, which are produced by increased activity of microbes such as fungi, bacteria, yeasts, actinomycetes and algae (Arancon *et al.,* 2004). These results are in agreement with those obtained by Afifi *et al*., (2010) who indicated that foliar spray with humic acid improved nutrient status and promoted growth and yield components of faba bean plants. Moreover, humic substances could improve the nutrient utilization and lower environmental pollution through reducing the amount of fertilizers added to soil (Abou-ElNour, 2002). In this regard, Hu and Wang (2001) mentioned that humic acid used as soil treatment or as spray at the seedling stage significantly increased the growth and yield of soybean plants. Similarly to these results, Gad El-Hak et al., (2012) found that foliar application of pea plants with humic acid is very beneficial to the crop growth and yield.

The data in Table (2) show the exhibiting interaction effect of the used treatments on the studied characters which is notably appeared in combined treatments between K-50% as soil application and foliar application of humic substances at the rate of (1g/L) with molybdenum which was superior to others and achieved a significant effect on 100-seed weight , seed and straw yield. These results indicated that there was a synergist effect on growth parameters between Mo and K as well as K fertilizer could enhance the beneficial effect of Mo on all growth parameters. In this connection, Abd El-Latif, Amina (2006**)**reported that the combined treatment of Mo and K was found to be the most effective one, and recorded the highest values of vegetative growth parameters and total yield.

(Table 2):The effect of Potassium fertilization along with molybdenum and humic substances on faba bean yield and its components (Mean of two seasons)

Treatments(B)	No. pods/plant			Weight of pods /Plant (g)			100 seeds weight (g)			Straw yield , (kg/fed)			Pod yield (Kg/fed)			Seed yield (Kg/fed)		
	Mo_0	Mo_1	Mean	Mo_0	Mo_1	Mean	Mo_0	Mo_1	mean	Mo_0	Mo_1	mean	Mo_0	Mo_1	Mean	Mo_0	Mo_1	mean
T_1	12.7	13.0	12.9	61.2	62.0	61.6	91.87	98.37	95.12	2189	2995	2508	1835	1890	1863	1318	1534	1426
T_2	12.0	12.3	12.2	57.4	59.7	58.5	88.10	91.87	89.98	2018	2826	2507	1722	1820	1771	1140	1383	1261
T_3	14.7	13.7	14.2	64.3	65.3	64.8	93.63	96.17	94..9	2826	2888	2857	1930	1990	1690	1542	1670	1606
T_4	15.0	17.0	16.0	65.7	67.7	66.7	93.97	93.63	93.8	2849	2919	2884	1970	2060	2015	1640	1900	1770
T_5	13.3	14.0	13.7	61.3	62.3	61.8	96.93	103.07	100.0	2963	2851	2907	1840	1900	1870	1717	1771	1744
Mean (A)	13.5	14.0		62.0	63.4		92.90	96.62		2569	2896		1859	1932		1471	1652	
L.S.D (A)		N.S			0.7			0.09			326			45			104	
(B)		2.0			0.6			0.97		79				24			131	
(AB)		N.S			N.S			1.36			112			N.S			N.S	

T_1- Potassium sulphate as soil addition at 50 kg fed^{-1} (full recommended rate:FR) control
T_2- Potassium sulphate as soil addition at half recommended rate (HR)
T_3- Potassium sulphate as soil addition at half recommended rate (HR) + 1% potassium sulphate as foliar application.
T_4- HR + humic acid (1g/litre).
T_5- HR + humic acid (2g /litre).

The concentration and uptake of macronutrients in seeds:

Statistical analysis in Tables (3 and 4) indicated that N%, K%, protein% but not P%, as well as, N,P and K uptake were significantly increased due to foliar application of molybdenum . Data clearly indicate that in presence of molybdenum, minerals composition in seeds significantly increased. This may be explained on the basis of the obtained results by Bhagiya *et al.*, (2005) who found that molybdenum at rate 4.0 kg per ha increased groundnut seeds N, P and K contents. Molybdenum foliar spray of broad bean plants is important under sandy soil condition for increasing total yield and N content in seeds (Metwally *et al.*, 1995)

These results are in harmony with those obtained by Nadia Gad (2012) who stated that Mo was significantly increased mineral content in groundnut seeds. The increment of N content of broad bean plants by Mo addition may be attributed to the role of Mo in normal assimilation of N by plants. It is important for nitrate reeducates enzyme which is essential in the assimilation of nitrate since it catalyzes the first step of the reduction of NO_3 to NH_4. Similar results were obtained by Shehata (2001) and Bayoumi et al., (2002). Also, the increments of P and K content of broad bean plants by Mo addition may be attributed to the improving of N fixing activity of the root nodules and hence increase the vegetative growth and consequently increase P,K and other nutrients uptake. Also, Viera *et al.*, (1998) stated that molybdenum application resulted in enhanced total nitrogen accumulation in seeds as well as seeds protein content of *phasolus vulgaris* compared with the control. In another study related with different Mo application in chickpea, Oguz (2004) reported that the highest protein percentage was obtained from 6 gm Kg-1 seed Mo application.

Concerning the effect of adding K-5o% from FD as soil application along with foliar spray of 1% potassium sulphate irrespective of molybdenum , Tables (3 and 4) clear a positive effect of K- application on the concentration and uptake of N,P,as well as protein % of faba bean seeds and this may be due to the role of K in activating protein synthesizing enzymes and /or increasing N content in grain which reflected the increase in the protein content.

These results are compatible with Abou El-nour(2002) who found that appling 36kg K_2O supplemented with foliar potassium feeding showed the highest leaf N and K. Furthermore, El-Shikha *et al.*,(2005) reported that potassium fertilization must be applied to sandy soil at a rate of 48 kg K_2O/fed.in three splitting doses i.e. at sowing, during the vegetative and flowering growth stages to overcome the disturbance of nutritional balance in soil and for attaining the best seed protein yield in sandy soil. It can be noticed that the foliar application increased the K concentration and the results showed the benefits of foliar applied plant nutrients in treatments with half rates of K fertilization (Paul and Qaiyyum. 2009). Foliar supplements of fertilizers can compensate for the constraining effect on nutrients availability and uptake usually presented in the new reclaimed lands (El-Habbasha *et al.*,2012). Besides , the content of protein in the seed was significantly dependent on potassium fertilization (Barlong *et al.*, 2014). El-Nimr , Hanyiat *et al*.(1997) .

Lastly, the foliar application is a convenient and efficient operate and provides a low-cost approach for correcting K deficiency by allowing low rates frequent applications (Rolston *et al.,* 1979). The efficiency of foliar fertilization is higher than that of soil application because of the supply of the required nutrient directly to the location of demand in the leaves, and its relatively quick absorption, Roemheld and El-Fouly (1999).

Thus,the use of macro and micro nutrients through foliar fertilization is preferable to avoid not only nutrients fixation in the soil, but also leaching during irrigation and correct any defecient in the soil.

As shown in Tables (3 and 4), foliar supply of humic substances from(1 to 2 g/L) with K-50% soil application progressively increased the percentages of N, P, K and protein as well as NPK uptake compared with the sole K treatment . This is probably due to the role of humic substances in providing the plant with required nutrients which may one or more of them were insufficiently supplied through the roots system in such low fertile soil. The combination between K-50% and humic substances at the rate of 1g/L gave the highest N, P, K and protein contents compared to other treatments. It is interesting to mention that the high increased uptake could be explained as results of the remarkable increase in the seed yield achieved by this treatment. These results are in harmony with those reported by (Unlu, *et al*., 2011, Shehata, *et al*., 2012 and Abdel-Razzak and El-Sharkawy, 2013). They reported that there were considerable increases in protein, nitrogen, phosphorus and potassium contents of legume crop which fertilized by humic acid

Table 3.The effect of Potassium fertilization along with molybdenum and humic substances on concentrations of N,P,K and protein in faba bean seeds (Mean of two seasons)

Treatments(B)	N%			P%			K%			Protein %		
	Mo_0	Mo_1	mean	Mo_0	Mo_1	mean	Mo_0	Mo_1	Mean	Mo_0	Mo_1	Mean
T_1	3.57	4.53	4.05	0.503	0.530	0.517	0.72	0.65	0.69	22.33	28.33	25.33
T_2	3.90	4.69	4.30	0.560	0.567	0.563	0.72	0.68	0.70	24.38	29.31	26.84
T_3	4.38	4.94	4.71	0.557	0.500	0.528	0.70	0.67	0.69	27.98	30.88	29.43
T_4	4.47	4.62	4.54	0.500	0.533	0.517	0.69	0.67	0.68	27.92	28.85	28.39
T_5	4.40	4.31	4.36	0.547	0.520	0.533	0.68	0.64	0.66	27.50	26.94	27.22
Mean(A)	4.16	4.62		0.533	0.530		0.70	0.67		26.02	28.86	
L.S.D (A)		0.35			N.S			0.02			2.25	
(B)		0.26			0.03			0.03			1.63	
AB		0.37			0.05			NS			2.30	

T_1- Potassium sulphate as soil addition at 50kg fed^{-1} (full recommended rate :FR) control
T_2- Potassium sulphate as soil addition at half recommended rate (HR)
T_3- Potassium sulphate as soil addition at half recommended rate (HR) + 1% potassium sulphate as foliar application.
T_4- HR + humic acid (1g/litre).
T_5- HR + humic acid (2g /litre).

Table 4.The effect of Potassium fertilization along with molybdenum and humic substances on uptake of N,Pand K in faba bean seeds(Mean of two seasons)

Treatments(A)	N uptake(Kg/fed)			P uptake(Kg/fed)			K uptake (Kg/fed)		
	Mo_0	Mo_1	mean	Mo_0	Mo_1	Mean	Mo_0	Mo_1	Mean
T_1	47.09	69.56	58.33	6.60	8.13	7.36	9.52	10.0	9.76
T_2	44.41	64.97	54.69	6.39	7.83	7.11	8.22	9.40	8.81
T_3	68.91	82.48	75.69	8.59	8.34	8.47	10.85	11.19	11.02
T_4	73.11	87.70	80.40	8.18	10.12	9.15	11.33	12.73	12.03
T_5	75.66	76.31	75.98	9.38	9.21	9.29	11.74	11.34	11.54
Mean (A)	61.83	76.20		7.82	8.73		10.33	11.01	
L.S.D (A)		4.71			0.11			0.48	
B		6.34			0.53			1.02	
AB		8.96			0.75			N.S	

T_1- Potassium sulphate as soil addition of 50 kg fed^{-1} (full recommended rate:FR) control
T_2- Potassium sulphate as soil addition at half recommended rate (HR).
T_3- Potassium sulphate as soil addition at half recommended rate (HR) + 1% potassium sulphate as foliar application.
T_4- HR + humic acid (1g/litre).
T_5- HR + humic acid (2g /litre).

Moreover, humic substances are mostly used to remove or decrease the negative effects of chemical fertilizers from the soil and stimulate the plant growth by the assimilation of major and minor elements, enzyme activation and/or inhabitation, changes in membrane permeability, protein synthesis and finally the activation of biomass production (Ulukan, 2008). These results are in line with those obtained by Unlu, *et al* (2011), shehata, *et al* (2012) and Abdel-Razzak and El Sharkawy (2013).

Regarding the effect of interaction among the studied treatments on N% , P%, K%, protein% and NPK uptake, the data given in Tables (3and4) reveal that there were a significant effect on N% , P% and protein% as well as N and P uptake in combined treatments between K-5o% as soil application and foliar application of humic substances at rate (1g/L) with molybdenum was superior to others , while, the insignificant decrements in some nutrients could be as a result of dilution effect. In this connection, Abd El-Latif,Amina (2006) reported that the combined treatment of Mo and K was found to be the most effective one and recorded the highest values of seed protein content, carbohydrates content, N,P,K and Mo percentage of broad bean plants grown on a sandy soil.

The aforementioned results means that foliar application of Mo or humic substances not only reduce the amounts of soil potassium application but also have a positive effect on yield and its quality.

CONCLUSION

The results revealed the possibility of reducing farming costs through reducing the amount of soil potassium fertilizers applied to faba bean through foliar feeding of potassium, humic substances and molybdenum in sandy soil to improve the quantity and quality of faba bean yield.

REFERENCES

Abd El-Latif, Amina, M.(2006).Effect of potassium and foliar spraying with molybdenum on broad bean plants grown on a sandy soil. Egypt J. Appl. Sci., 21:309-330.

Abdel-Razzak, H.S and G.A. El-Sharkawy (2013). Effect of bio-fertilizer and

humic acid applications on growth, yield, quality and storability of two garlic cultivars. Asian J. of Crop Sci., 5(1): 48-74

Abou El-Nour, E.A.A.(2002). Can supplemented potassium foliar feeding reduce the recommended soil potassium? Pakistan J. of Biological Science 5(3) : 259-262.

Afifi,M.H.M.; M.F. Mohamed and H.A. Shaaban (2010). Yield and nutrient

uptake of some faba bean varieties growth in newly cultivated soil as affected by foliar application of humic acid. J. of Plant Production. 1(1):77-85.

Ahmed, N.(1998). Foliar Fertilization in Pakistan. Statues,scope and constraints. Proc.Symp."Foliar Fertilization :A Technique to improve Production and Decrease Pollution"10-14Dec.1995 Cairo,Egypt, Eds. El-fouly M.M.;Abdalla and A.A.Abdel-Maguid, Publ.N.R.C., Cairo,7-15.

Arancon, N.Q., C.A. Edwards;P. Baiermaa, C.Welch and J.D. Metzger (2004a). Influence of vermicomposts on field strawberries. Bioresource Technol.,93(2) :145-153.

Barlong, B. (2014). Effect of sulpher fertilization on seed yield and yield

components of broad bean on the background of different levels of potassium content in soil. Fragm. Agron. 31(2):7-17.

Bayoumi, N.A.; E.A. Abou Hussien and S.F.El-Fiki (2002). The combined

effect of nitrogen,zinc and molybdenum on organic yield of maize plants and its chemical composition.Minufiya J.Agric.Res.,27:717-733.

Bhagiya, S.R. ; K. B. Polara and J.V. Polara (2005). Effect of B and Mo on yield, quality and nutrient absorption by groundnut. Advances in Plant Sciences. 18 (2) : 803- 806.

Black,C.A.;D.D.Evans;L.E.Ensminger;G.L.White and F.E.Clark(1962). Methods of Soil Analysis. Am. Soc. Agron. Inc. Pub. Madison ,Wisconsin,USA.

Cakmak ,I. (2005). The role of potassium in alleviating detrimental effects of

abiotic stresses in plants. J. plant Nurt. Soil Sci. 168 : 521 – 530.

Chapman, H.D. and P.F. Pratt (1961). Methods of Analysis for Soils, Plants and Water.Agric.Publ. Univ., of California, Reverside,USA.

El-Beheidi, M.A.; A.M. Metwally and A.A.El-Mansi (1995).Isoperoxidase polymorphism and root system in pea plants and their response to phosphorus and molybdenuim. Zagazig J. Agric.Res.,22:142-149.

El–Habbasha, S.F.,G.Amal Ahmed and Magda H. Mohamed (2012).Response of some chickpea varieties to compound foliar fertilizer under sandy soil conditions. Journal of Applied Sience Research, 8(10):5177-5183.

El-Nimr Hanyiat M.;A.A.Attiat ;F.Zahran ;S.M.M.El-Saadany and N. S. Rizk (1997). The response of corn (Zea mays L.).Egypt J.Appl.Sci.,12:53-72.

El-Shikha, S.A.;M.O. Easa ;E.M.K. Behiry and M.I.Raslan (2005).Effect of K-fertilization on faba bean productivity under sandy soil condition. Egypt J.Appl.Sci.,20:335-344.

Erik, B., G. Feibert, C. Clint and L.D. Saunders (2000). Evaluation of humic acid and other nonconventional fertilizer additives for onion production. Oregon State Univ. Ontario, 2000.

Ewa,J.;A.Kotecki and M.Kozak (2004) Effect of foliar fertilization of micronutrients on common bean (Phaselus vulgaris L.) development and seed yielding. Electronic J. of Polish Agric.,Univ.Agron.,Volume7 Issue1

Gad El- Hak, S. H., A.M. Ahmed, and Y.M.M. Moustafa (2012). Effect of foliar application with tow antioxidants and humic acid on growth, yield and yield components of peas (*Pisum sativum L.*). Journal of Horticultural Science & Ornamental Plants (3) : 318-328.

Ghabbour, E.A. and G. Davies (2001). Humic substances: Structures, models and functions, Royal Society of Chemistry, England.

Hala Kandil, Nadia Gad and Magdi T. Abdelhamid(2013). Effect of different rates of phosphorus and molybdenum application on two varieties common bean of *(Phaseolus vulgaris L.)*. J. Agric. Food Tech. 3(3) 8-16.

Hu, Sh. and R. Wang (2001). A study on the effect of Komix, Humic acid containing organic fertilizer,on spring soybean. Acta Agriculturae Universitatis Jiangxiensis,23(4):463-466.

Larcher, W.(2003). Physiological Plant Ecology: Ecologysiology and stress physiology of functional groups,4th Edition,Springer,New York.

Lifang, H. ; S. Fan; Z. Zongsheng; F. Libo (2000). A systematic approach to balancing soil nutrients in broad bean – rice rotation in Yunnan. Better Crops International 14: 18-23.

Marschner, H.; E. A. Kirkby; J. Cakmak (1996). Effect of mineral nutritional status on shoot – root partitioning of photo – assimilates and cycling of mineral nutrients. J. Exp. Botan. 47 : 1255-1263.

Mengel, K. and E. A. Kirkby(2001). Principles of plant nutrition. 5th ed. Kluwer Acadimic Publishers. pp:849.

Metwally, A.M.; A.A. El-Mansi; M.A. El-Beheidi ;A.A. Guirgis and S.A. Swidan (1995). Effect of phosphorus and foliar spray with molybdenum on some morphological chracters and yield of pea. Zagazig J.Agric. Res.,22:1463-1477.

Mohamed, M., A. Manullah, S. Sekar and S. Vincent (2010). Plant growth substances in crop production: A review. Science Alert. 215-222.

Moussa, B.I.M. (2000) Response of wheat plants growth in sandy soils to K and some micronutrients fertilization. Egypt J. Soil Sci., 40 (4):481-493.

Nadia Gad(2012). Influence of Molybdenum on Groundunt prodnction Under Different Nirtogen Levels. World Journal of Chemistry 7(2) : 64- 70.

Nassar,K.E.M. ; Sh. M.Abd El-Rasoul and G.M.El-Shebiny (2005). Effect of foliar spraying with phosphorus and potassium on faba bean plant under calcareous soil conditions. Minufiya J. Agric.Res.,30:1625-1637.

Niranjana,H.G.;S.S.Prakash;Basavegowda;N.A.Yelladhalli and H.T.Chandranath. (2005). Effect of micronutrients seed treatments on growth and yield of groundnut. seed Research. 33(2): 138-141. nutrition of maize, Bioresource Technology, 99: 4206-4212.

Oguz, F. (2004) Research on the effects of different Levels molybdenum application on the yield and some yield components in chickpea varieties on dry and irrigation condition. M.Sc. Thesis, Yuzuncu Yil University Van, Turky..

Oosterhuis, D.M.(1998). Foliar Fertilization of Cotton## in the USA. proc. Symp. " foliar fertilization : A Technique to Im prove Production and Decrease Pollution " 10-14 Dec. 1995 Cairo, Egypt, Eds El Fouly MM.,FE. Abdalla and A. A. Abdel. Maguid, publ. NRC. Cairo, 49-64

Page, A. L. (1982) "Methods of Soil Analysis"II: Chemical and Microbiological Properties, 2nd ed. Soil Sci. Am. Inc., Madison, USA.

Paul, N.K. and M.A. Qaiyyum (2009). Effect of different levels of NPK fertilizers and irrigation on yield and nutritive quality of mulberry leaf. Bangladesh. J. Agir. Res., 34 (3) : 432 -442. Przemyslaw Barlog, Alicja niewiadomka2 katarzyna Ambrozy-Dsregowska. recovery by corn. Zagazig. J. Agric. Res. 19:573.

Piper,C.S.(1950). Soil and Plant Analysis . Inter.Sci. Pub. Inc.,New York,p.368.

Reddy, K. J.; L. C. Munn and L. Wang (1997). Chemistry and Mineralogy of Molybedenum in Soils. In : Gupta UC, ed. Molybedenum in Agriculture. Cambridge University press.

Rizk N.S.(2003).The combined effect of phosphorus and molybdenum on broad bean plant growth and its chemical composition. Minufiya J.Agric. Res.,28:625-636.

Roemheld, V. and M.M. El fouly (1999). Foliar nutrient application : Challenge and limits in crop production. Proc 2nd Int. Workshop on " foliar fertilization " 4- 10 April, 1999, Bangkok, Thailand, 1-32.

Rolston D.E. ; R.S.Rauschkolb ;C.J. Phene ; R.J. Millar ;K. Uriv; R.M. Carlson and D.W. Henderson (1979). Applying of nutrients and other to trickle irrigated crops. Univ. of Calf. Bull. 1893, Berkeley, California. Pp14

Shehata, A.M.M. (2001). Effect of molybdenum on nitrogen availability in soils and metabolism in plant. Ph.D.Thesis Fac. Agric.Minufeya Univ.

Shehata, S.A.; Y.M. Ahmed; T.Y. Emam and M.A. Azoz (2012). Influence of some organic and inorganic fertilizers on vegetative growth, yield and yield components of cucumber plants. Research J. of Agric. and Biolo Scie 8(2): 108-114.

Snedecor,G.W. and W.G.Cochran.(1990).Statistical Methods,8th Ed. Iowa State Univ.,Press,Ames,Iowa, USA. State Univ. Ontario, 2000.

Ulukan,H. (2008). Effect of soil applicationof humic acid at different sowing times on some yield components in wheat hybrids. Int.J.Bot.,4(2):164-175.

Unlu H.O.;H. Unlu; Y. karakurt and H. Padem (2011). Changes in fruit yield and quality in response to foliar and soil humic acid applications in cucumber. Scientific Research and Essays., 6(13): 2800-2803

Vieira,R.F.;E.J.B.N.Cardoso;C.Vieira and S.T.A.Cassini (1998). Foliar application of molybdenum in common bean.111.effect on nodulation. J. Plant Nutri.,21:2153-2161.

Yildirim,E.(2007). Foliar and soil fertilization of humic acid affect productivity and quality of tomato. Acta Agriculturae Scandinavica Section B-Soil Plant Science, 57:182-186.

Yilmaz, C. (2007). HÜmik ve FÜlvik asit, Hasad bitkisel Üretim, Ocak, 260:74

Yuncai,Bur, Hues,Z. and U.Schmidhalt(2008). Effect of foliar fertilization application on the growth and mineral nutrient content of maize seedling under drught and salinity. J.Bot.,1747-1765.

استخدام التسميد البوتاسى مع الرش بالمواد الهيومية والموليبدنم فى الفول البلدى

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اجريت تجربتان حقليتان خلال الموسم الشتوى 2013/2012 و 2014/2013 فى ارض رملية بمزرعة خاصة بقربة الشعراوى –مركز البستان – محافظة البحيرة وذلك بهدف دراسة تأثير استخدام التسميد البوتاسى بمفرده عن طريق الاضافة الارضية بالجرعة الموصى بهاو باستخدام نصف المعدل الموصى به من التسميد البوتاسى مرتبطا مع الرش بسلفات البوتاسيوم وايضا استخدام الرش بالمواد الهيومية بمعدلين 1جم/لتر و2جم/لتر وذلك فى وجود او غياب الرش بالموليبدنم(6 جزء /المليون) وتأثير هذه المعاملات على زيادة انتاجية محصول الفول البلدى. ويمكن تلخيص النتائج النتحصل عليها فى النقاط الاتية:أدى الرش بمحلول الموليبدنم الى حدوث زيادة معنوية لكل من المحصول ومكوناته (وزن القرون/نبات- وزن 100 بذرة –محصول الحبوب والقرون والقش/الفدان) ما عدا عدد القرون بالاضافة الى زيادة تركيز النيتروجين والبوتاسيوم والبروتين فى البذور وكذلك زيادة الممتص من هذه العناصر. أدت الاضافة الارضية من البوتاسوم بمعدل 50% من الجرعة الموصى بها مع الرش الورقى بسلفات البوتاسيوم 1% أو المواد الهيومية(1 أو 2 جم/لتر) بغض النظر عن معاملة المولبدنم الى حدوث تأثير ايجابى على المحصول ومكوناته وذلك بالمقارنة مع الاضافة الارضية من البوتاسيوم بمعدل 100% أو50% من الجرعة الموصى بها بالاضافة الى زيادة تركيز النيتروجين والفوسفوروالبوتاسيوم والبروتين فى البذور وكذلك زيادة الممتص من هذه العناصرفى البذور وذلك بدون فروق معنوية بين هذه المعاملات الثلاثة فى معظم الحالات, وقد تحقق أعلى محصول للقرون أو البذور بالاضافة الى وزن القرون /نبات باستخدام نصف المعدل من البوتاسيوم أرضيا مع الرش بالمواد الهيومية بتركيز1جم/لتر بينما تحقق أعلى محصول للقش ووزن 100 بذرة بالرش بالتركيز الأعلى من المواد الهيومية (2جم/لتر)أظهرت النتائج المتحصل عليها ان أفضل تأثير للتفاعل بين المعاملات على المحصول ومكوناته قد لوحظت نتيجة المعاملة الثلاثية (الاضافة الارضية من البوتاسيوم بمعدل 50% من الجرعة الموصى بها+ الرش بالمواد الهيومية بتركيز1جم/لتر+ الرش بالموليبدنم) والتى تفوقت على باقى المعاملات الأخرى وبذلك يمكن أن توفر نصف معدل السماد البوتاسى اللازم لمحصول الفول البلدى.