World Wide Journal of Multidisciplinary Research and Development

WWJMRD 2016; 2(2): 52-58
www.wwjmrd.com
e-ISSN: 2454-6615

Manal A. Atiia
Agriculture Research Center, Soils, Water and Environment Research Institute, Giza, Egypt

Manal A. AbdAlla
Agriculture Research Center, Soils, Water and Environment Research Institute, Giza, Egypt

Allam S.M.M.
Agriculture Research Center, Soils, Water and Environment Research Institute, Giza, Egypt

Correspondence:
Manal A. Atiia
Agriculture Research Center, Soils, Water and Environment Research Institute, Giza, Egypt

Effect of zinc and cobalt applied with different methods and rates on the yield components of *Vicia faba* L.

Manal A. Atiia, Manal A. AbdAlla, Allam S.M.M.

Abstract
Faba bean (*Vicia faba* L.) is one of the main leguminous crops grown in winter season in different soils of Egypt. The aim of this study is to show the effect of applying zinc (Zn) and cobalt (Co) in different methods (foliar and soaking) and rates in increasing broad bean yield and its components. Broad bean seeds were applied with Zn and Co as foliar in two rates for each element in twice time**.** Application of the two methods and different rates of Zn, Co and the interaction between them showed that all treatments significantly augmented broad bean yield and its components rather than control treatments. The results clearly indicate that the percentage of N, P and K in response to the different methods and rates recorded significant increase in comparison with untreated plants. It could be observed that Fe, Mn, Zn and Co concentrations were increased significantly in broad bean seeds with different methods application and different rates of Zn, Co and their combination as compared with control. Concerning the effect of Co and Zn addition by different methods and rates on macro-micronutrients all cobalt treatments significantly increased nutrients status (except Fe content) and the chemical contents of broad bean seeds when compared with the control treatment.
It could be concluded that irrespective of fertilization factor of soaking technique seems to be more efficient than the spraying one for higher yield of faba bean.

Keywords: *Vicia faba* L., Zinc, Cobalt, Yield

Introduction
Faba bean (*Vicia faba* L.) is one of the main leguminous crops grown in winter season in different of Egypt soils. Also, it is considered as one of the basic sources of protein for human consumption. It is nutritionally important vegetable, containing 20–30 % protein for human and animal consumption. In addition, broad bean plants improve soil fertility by providing a substantial input of nitrogen fixation. So it enters in crop rotation to improve soil conditions (Carmen *et al*., 2005). Micronutrients are vital for plant growth. Soil and foliar applications are the most prevalent methods of micronutrient addition. Micronutrients seed treatments which include seed soaking and seed coating are an attractive and easy alternative. Improving plant micronutrient status in situations where micronutrient nutrition is inadequately supplied from the soil would increase yield. This however requires application of higher doses of fertilizer to soils because of low nutrient-use efficiency (Singh. 2007).Seed priming is a technique in which seeds are soaked in solutions of low water potential that initiates pre-germinative metabolic activity but prevents radical protrusion (Farooq *et al*., 2006; Janmohammadi *et al.,* 2008). However, the beneficial effects of seed priming have been well documented in many research based published data include early germination; improves germination rate (Ghassemi-Golezani *et al.*, 2008); improves seedling vigor (Saber *et al*., 2012); strengthens stand establishment (Diniz *et al.*, 2009) and increase yield (Yilmaz *et al.,* 1998). Besides all these beneficial effects, seed priming also reduce leakage of metabolites, repairs deteriorated seed' parts, improve RNA and protein synthesis (McDonald, 2000). Recent research has revealed that micronutrient problems are also hampering crop production (Nasef *et al*., 2006). Foliar application occurs at later growth stage when crop stand are already established. Foliar application of nutrients is a more suitable option compared with soil fertilization when the roots cannot provide necessary nutrients. Other advantages are quick compensation of nutrient deficiency and application of lesser rates thus, reducing toxicity arises from excessive accumulation of elements and

preventing nutrients fixation in the soil (Malakouti and Tehrani, 1999). Symbiotic nitrogen fixation in legumes is depended on both the content and availability of essential micro-nutrients in the soil. Cobalt supply enhances nitrogen fixation in all Rhizobim species and hence, promotes legume growth (Collins and Kinsela, 2011). Cobalt is a component of vitamin B_{12} which is a component of enzymes and co-enzymes involved in nitrogen fixation in legume nodules (Mathur *et al.*, 2006). Nadia (2013) pointed that cobalt at 8 ppm had a greatest pods yield quantity and quality of peas compared with the control. Hala (2007) showed that cobalt significantly increased faba bean growth and yield (pods and seeds) she added that cobalt significantly Increased nodules formation in faba bean roots. In this connection, (Palit *et al.*, 1994) reported that Co is an essential component of several enzymes and co-enzymes. Its beneficial effects include retardation of leaf senescence, inhibition of ethylene biosynthesis and stimulation of alkaloid biosynthesis in medicinal plants. Moreover, cobalt reduces the peroxidase activity which is known to affect the breakdown of indole acetic acid (IAA). It has a role in effecting growth and metabolism of plants in different stages, depending on the concentration and status of cobalt in rihzosphere and soil (Palit and Sharma, 1994). Given the low downward mobility of Co in the plant, its rapid movement from aboveground parts to the root rather than in the opposite direction, and the insufficient uptake through the root system (regardless of its soil content), The total Co level in the soil includes Co bound in insoluble forms with minerals or locked within stable crystalline structures, and is unavailable to plants (Collins and Kinsela, 2011). Zinc is a micronutrient needed in small amounts by crop plants. It is considered to be the most yields-limiting micronutrient in crop production in various parts of the world (Duffy, 2007). Ozturk *et al*. (2006) found that Zn in newly-developed radicles and coleoptiles during seed germination was much higher (up to 200 mg kg') thus highlighting the involvement of Zn in physiological processes during early seedling development, possibly in protein synthesis, cell elongation membrane function and resistance to abiotic stresses (Cakmak, 2000). In addition, higher seed Zn contents may better resist invasion of soil-borne pathogens during germination and seedling development thus ensuring good crop stands (Marschner, 1995) and ultimately better yield. In addition, Potarzycki and Grzebisz (2009) reported zinc exerts a great influence on basic plant life processes, such as (i) nitrogen metabolism-uptake of nitrogen and protein quality; (ii) photosynthesis-chlorophyll synthesis and carbonanhydrase activity. Zinc (Zn) is known to have an important role either as a metal component of enzymes or as a functional, structural or regulatory co factor of a large number of enzymes (Grotz and Guerinot 2006). However, it depends on soil Zn status; for instance, in the case of moderate deficiency, seed priming was a cost-effective method of Zn application (Harris *et al.,* 2008).

Materials and Methods

Vicia faba L. (cv. Giza 483) pot experiments were conducted in the green house of Agriculture Research Station in Giza during two successive seasons 2012-2013 and 2013-2014 on clay loam soil (7kg/pot) to study the effect of applying Zn and Co in different methods (foliar and soaking) and rates in increasing broad bean yield and its components. Some physical and chemical properties of the soil before planting are shown in table (1).

Table 1: Physical and chemical properties in soil study

Property	Value	Property	Value
Particle size distribution			
Clay%	50.66	Soluble ions (mmol L^{-1})	
Silt%	28.5	Na^+	13.25
Sand%	14.28	K^+	0.67
Textural class (2)	Clay	Ca^{++}	7.84
EC (dSm^{-1}) in soil paste extract	2.65	Mg^{++}	4.88
		Cl^-	5.01
pH[Soil suspension 1:2.5]	7.90	HCO_3^-	3.22
Organic matter (g kg^{-1})	2.05	$SO_4^=$	18.33
$CaCO_3$ (g kg^{-1})	8.15		

Available macro and micronutrients (mg kg^{-1} soil)					
N	P	K	Fe	Mn	Zn
72.85	4.05	334	1.99	1.56	0.88

The experimental design was complete randomized with three replicates; seeds were coated with okadin using Arabic Gum. Zn was applied as chelated in the form of EDTA compound (Zn EDTA 15%), while, Co was applied as $CoSO_4$.

Broad bean seeds were applied with Zn and Co as foliar in two rates for each element in twice time and the treatments were carried out as follows:

1- Control (water)
2- Spraying Zn at two rates (0.4and 0.6g/L)
3- Spraying Co at two rates (0.24 and 0.48 g/L)
4- Spraying solution contain (0.4g Zn+0.24 g Co/L)
5- Spraying solution contain (0.4g Zn+0.48g Co/L)
6- Spaying solution contain (0.6g Zn+0.249 Co/L)
7- Spraying solution contain (0,6g Zn+048g Co /L)

Also, seeds were soaked for 24 hours before sowing in the following different solutions.

1- Control (in water)
2- Zn solution at two rates (0.1and 0.2g/kg seeds)
3- Co solution at two rates (0.07and 0.14g/ kg seeds)
4- Nutrient solution containing (0.1g Zn+0.07g Co)
5- Nutrient solution containing (0.1g Zn+0.14g Co)
6- Nutrient solution containing (0.2g Zn+0.07g Co)
7- Nutrient solution containing (0.2g Zn+0.14g Co)

A basal dose of were added to each pot before sowing at the rate sowing broad bean was carried out at the 1st and 5ththe October in both season. At harvest, seeds and straw yield were recorded dry weight of Seed samples from each treatment were taken for chemical analysis; seed samples were wet digested using H_2SO_4 and $HCLO_4$ acid mixture 1:1 (v/v). The digest was then used to determine N, P and K concentration as descended by Chapman and Pratt (1961). As well as described by Chapman and Pratt (1961). As well as Zn, Fe, Mn, Cu and Co concentrations were determined using atomic absorption spectrophotometer (GBC 932). All the obtained data were statistically analyzed according to Snedecor and Cochran (1979).

Results and Discussion

Faba bean yield and yield components

Data illustrated in Table (2) show the No. of seeds, pods, straw and seed yield/plant. Application of the two methods and different rates of Zn, Co and the interaction between them showed that all treatments significantly augmented broad bean yield and its components rather than control treatments. In foliar method, results cleared that the highest values were achieved by using Zn_1,Co_1 lonely and recorded 21.33 and 26.7 for No. of seeds, 20.27 and 25.24 for pod yield/plant,11.63 and 18.69 for straw yield as well as 19.4 and 19.29 for seed yield/plant. Regarding the combined treatments, Zn_2Co_2 was superior treatment compared with other interaction and gave the highest values of No. of seeds, pod yield, straw yield and seed yield and recorded 26.33, 25.94, 23.56 and 20.26 g/plant respectively.

In order to evaluate the effect of soaking method on yield and its attributes, the data in table (2) illustrate the exhibited in the studied traits by applying Zn_2 and Co_1 solely and the combined treatment namely Zn_2Co_1 and recorded 31.33, 37.33, and 39.0 for No. of seeds, respectively. Also, the data recorded 27.77, 36.53, 31.49/plant for straw yield and were 21.74, 30.14 and 35.0 g/plant for seed yield. From the above mentioned discussion of all the considered elements it could be concluded that irrespective of fertilization factor the soaking technique seems to be more efficient than the spraying one for higher yield of broad bean plant in the two studied seasons. The foliar application with two doses of zinc contributed in improving the overall growth of the plant without any side effect to absorb phosphorus and other elements as in the ground handling of zinc. This encouraged the growth of leaves; production and supplying of carbonate material for the root nodules and increased the concentration of zinc in the plant and the nodules. This has positive impact on the weights of root nodules. Seifi *et al.*, (2011) indicated that Zn and Mn foliar application noticeable raised common bean yield and its components. Berglund (2002) noted that Zn foliar application particularly increased soybean seed yield. Bozoglu *et al.* 2007) stated that application of micronutrients (Zn) on chickpea could be implemented for higher yield and quality. Co in this study was applied foliarly; cobalt application had in general positive effects on yield components values and on seed yield. The indirect effect of Co on seed yield and on yield components was likely through increased nodulation and/or increased nitrogen fixation. Foliar treatment with Co_2 is assumed to lead to a more efficient and optimal status of a cobalt in the root and in the nodules, in comparison with soil application. In order to the foliar treatment with cobalt, it can be noticed that in general the foliar application by using Co_2 was accompanied by a positive effect on seed yield and seed yield components, as compared with control, a significant increase in seed yield, in the cobalt applied treatment, was obtained almost due the significant increase in seed number. This suggests that foliar cobalt treatment in future studies should be performed at the early stages of development i.e. during intensive growth in order to simulate nodulation and have greater nitrogen fixation in a needed timely manner. Concerning the effect of soaking seeds with Zn, Seed priming with Zn can improve crop emergences stand establishment, and subsequent growth and yield. In another study, seed priming with $ZnSO_4$ (0.1%) for 24 h increased stand establishment by 29% compared with the untreated control (Foti *et al.*, 2008). Also, seed priming with Zn was more effective in increasing grain yield of wheat grown on Zn-deficient soils than foliar and soil application. Nonetheless, seed priming did not affect the grain Zn concentration in contrast to foliar and soil. Both Kasab (2005) and Thalooth (2006) have obtained similar results who recorded that the application of zinc spray increased atmospheric nitrogen fixation and the proportion of protein in the seeds through the improvement of all measurement of plant growth, roots and thereby increasing the density of root growth in the soil and increase the numbers of the nodule by increasing the leaf area. Thus improve the production of carbonate compounds and supplying to nodules. They also noted that the application of zinc spray to the beans rose concentration in shoots. This increase was exploited in the composition of plant compounds that activate the enzyme action and thus improve the yield of the plant (Krishna, 1995). However, the results showed that Co_1 in soaking treatments gave the best values for the yield and indicated that higher cobalt levels had a depressive effect and caused reduction in yield. Excess of Co induces yield and an inhabitation in assimilate production in leaves, and even inhibits the export of photo assimilates to roots and other sinks (Rauser and Samarakoon, 1980). Also it causes oxidative stresses (Tiwari *et al.*, 2002) and may result in phytotoxicity to plants (chatterjee and Chatterjee, 2003). under lower cobalt application improve root system helped the plants in better absorption of water and another nutrients dissolved in it and consequently improved the growth of different organs and the entire plants. The improvement in the growth efficiency of plant organ might also be due to be beneficial effect of cobalt treatment on the physiological activities of plant which was responsible in improving the growth of plant and its component organs ultimately influencing the relative development of plant part their growth efficiency. In this connection, common bean, soaking seeds with cobalt nitrite at 1 and 5 mg/L significantly improved nodulation, dry matter, nitrogen and grain yield (Mohandas, 1985). Reddy and Raj (1975) obtained better nodulation and increased seed yields in soybean following foliar co application. Nadia *et al* (2013) concluded that cobalt significantly increased yield parameters of cowpea and the addition of cobalt saved about 25% of recommended nitrogen fertilizer dose. Therefore, it could be reduced the agricultural cost for more money to farmers. Faroq *et al*. (2012) and Geeth *et al* (2013) concluded that soaking of pea seeds in the combination CoCl + Ascorbic acid enhanced all the studied characteristic including yield and yield component and increased seeds content of nitrogen compare with control. In addition, seeds soaked in 0.25 0.50 and 1.00 ppm $CoSO_4$ produced 26, 40, and 56 % more fruit yield. Respectively, than the control (Atta-Aly, 1998) in common bean. Cowpea (*Vigna sinensis* L.) seed treatment with cobalt nitrate led to a significant increase in to number of nodules, number of effective nodules per plant, nodule weight and hence yield component values and total seed yield (Mathur *et al.*, 2006). Riley and Dilworth (1986) showed that the importance of cobalt to the growth and development of leguminasea plants was mainly due to the effect of cobalt on the activity and population of both atmospheric nitrogen micro-organisms of *Azotobacter* and *Nitrobacter*. These results are in harmony with Atta Aly *et al.* (1991) who found that favorable growth responses associated with low cobalt level attributed to low catalase and peroxidase enzymes activity. These enzymes are known to induce plant respiration possibly resulting in, successive consumption for products of photosynthesis and subsequently reduction plant growth. The positive effect may be due to cobalt application promotion of many developmental processes such as stem and coleoptiles elongation, opening of hypostyle hooks, leaf disc expansion and bud development as reported by Ibrahim *et al.* (1989). Also, the proper doses of cobalt may help in better nodulation and consequently a better growth and yield, but at high level cobalt reduced the bacterial population in the rhizosphere and as a result nodulation was hampered which led to a lower growth arid yield of crop (Jana *et al*., 1994). In general, the obtained results in this work arc in good agreement with those found by many investigators through their work on numerous plant species and varieties, as reported by Abdel-Moez and Nadia (2002) on cowpea and Basu *et al.* (2006) on groundnut, who stated that growth, fresh and dry materials, yield components as well as nodules formation of roots of the previous crops, were significantly affected by cobalt application. It's worthy to mention that the superiority of the applied methods can be ranked as soaking>foliar. This indicated the efficiency of applying micronutrients through seeds soaking method to correct micronutrients deficiency rather than foliar spray. Also, the results reported that treating broad bean seeds with a mixture of Zn and Co was more effective than using any of them individually. These finding could be interpreted as soaking give chance to ample amounts of applied micronutrients to be observed by the seeds; used later in the biological processes. This seems logic if comparing both foliar and soaking. But, at the same time one may expect that foliar spray correct micronutrients deficiencies for plant started already to suffer.

Table 2: Effect of zinc and cobalt applied with different methods and rates on No. of seeds/plant, pods yield/plant, straw yield/plant and seed yield/plant of *Vicia faba* L. plant.

Treatments	No. of seeds/plant			Pods yield/plant			Straw yield/plant			Seed yield/plant		
	Foliar	Soaking	Mean(B)	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)
Control	9.33	19.33	14.33	10.18	16.85	13.51	7.19	12.13	9.66	10.77	12.13	11.45
Zn1	21.33	22.67	22.00	20.78	21.53	21.16	10.71	14.75	2.73	19.40	17.46	8.43
Zn2	15.67	31.33	23.50	17.36	27.77	2.57	11.63	14.82	3.23	13.54	21.74	7.64
Co1	19.66	37.33	28.50	18.12	36.53	27.33	14.52	33.64	24.08	15.45	30.14	22.80
Co2	26.70	22.30	24.50	25.24	25.42	5.33	18.69	23.21	21.00	19.29	19.80	19.55
Zn1Co1	16.00	26.67	21.33	14.72	26.00	0.36	13.53	21.65	17.59	14.82	21.98	18.40
Zn1Co2	20.00	28.33	24.16	16.78	30.55	23.67	15.10	26.41	20.76	16.00	24.86	20.43
Zn2Co1	21.33	39.00	30.17	16.20	31.40	23.80	16.10	31.58	23.84	14.00	35.00	24.49
Zn2Co2	26.33	31.67	29.00	25.94	27.01	26.47	23.56	28.90	26.23	20.26	18.04	19.15
L.S.DA	**3.827**			**4.693**			**5.094**			**2.593**		
B	**2.356**			**2.172**			**3.517**			**2.265**		
A*B	**3.332**			**3.072**			**4.974**			**3.203**		

Nitrogen, phosphorus and potassium concentrations on broad bean

Data in table (3) show the effect of different methods and rates of Zn, Co and its interaction on the concentration of N, P and K in broad bean seeds. The results clearly indicate that the percentage of N, P and K in response to the different methods and rates recorded significant increase in comparison with untreated plants. In order to the effect of foliar application, the highest relative increase in concentration of N, P and K were 3.11, 32 and 2.11% by using $Zn_1$and Co_1, while, for the combined treatments Zn_2Co_2 gave the highest values (2.98%) for N, Zn_1Co_2 (0.29%) for P, Zn_2Co_1(1.77%) for K, respectively. As well as for soaking treatments, Zn_1 andCo_2 achieved the highest values and recorded 2.93, 32 and 1098% for N, P and K respectively. In order the soaking combined treatments the relative increase for N was 3.18 with Zn_2Co_2, 0.32 for P with Zn_1Co_2 and 2.04 for K with Zn_1Co_1, respectively. Also, the results clear that the interaction between the methods and rates was significantly affect. This means that increasing Zn and Co levels in foliar application decreased the content of N. P and K, while, in soaking treatments increasing cobalt level increased the content of N, P and K in broad bean seeds. Concerning the effect of Zn as foliar application, Tobbal (1999) found that the content of soluble protein in shoots of chickpea plant was increased in response to the treatment with Zn (100 ppm) as foliar spraying. Confirm these results, Nadia (2006) stated that addition of low Co level Co 7.5 ppm had significantly synergistic effect on the status of macro nutrients (N. P and K) in fruit of tomato plants and the higher concentrations of the cobalt being hazardous. Also, Basu *et al.* (2006) stated that application of low levels of Co significantly increased the status of macronutrients (N. P and K) in groundnut plants as compared with the higher levels.

The results reveal, as expected as mentioned by Abd El-Moez and Nadia (2002) that cobalt at 8 ppm increased macronutrients (N. P and K) content and increased the nodules formation of root and atmospheric nitrogen fixation by microorganisms which increase the nitrogen content in faba bean and cowpea plants. This was confirmed by Abdel-Moez and Nadia (2002), again, the obtained data disclosed the superiority of soaking treatments which contained a relatively high N, P and K compared to foliar application. These findings could be explained due to the role of micronutrients in enhancing the uptake of macronutrients. In this respect, El-Fouly and Fawzi (1996) noted that micronutrients application led to encourage the growth of root, which in turn take up higher contents of N, P and K and finally being reflected on the yield.

Table 3: Effect of zinc and cobalt applied with different methods and rates on Fe, Mn, Zn, Cu and Co of *Vicia faba* L. Plant.

Treatments	Fe			Mn			Zn			Cu			Co		
	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean
Control	35.00	38.66	36.83	10.33	11.33	10.83	44.67	55.00	49.83	11.33	14.33	12.83	0.33	0.40	0.37
Zn1	76.00	68.00	72.00	16.00	13.00	14.5	72.00	68.33	70.16	19.00	25.67	22.33	0.93	0.60	0.77
Zn2	73.00	53.67	63.33	14.33	16.33	15.33	56.33	62.33	59.33	14.33	17.67	16.00	1.13	0.13	0.63
Co1	64.33	78.67	71.50	15.67	14.33	15.00	54.66	61.00	57.83	17.00	15.33	16.17	4.63	0.30	2.47
Co2	65.33	53.33	59.33	14.00	16.00	15.00	51.67	64.00	57.83	18.33	17.67	18.00	9.40	0.43	4.92
Zn1Co1	45.66	92.00	68.83	15.33	21.67	18.50	55.33	69.00	62.17	20.00	31.00	25.50	4.90	0.20	2.55
Zn1Co2	41.33	77.00	59.16	16.33	19.33	17.83	51.33	79.33	65.33	19.33	19.66	19.50	8.47	0.27	4.37
Zn2Co1	75.33	76.00	75.67	12.33	18.33	15.33	60.33	70.00	65.16	19.67	29.33	24.50	1.80	0.60	1.20
Zn2Co2	48.00	89.00	68.50	18.00	19.33	18.66	52.33	69.33	60.83	19.33	35.67	27.50	7.73	1.37	4.55
L.S.DA	**9.649**			**1.304**			**2.072**			**3.447**			**1.076**		
B	**8.23**			**2.181**			**7.467**			**3.226**			**1.178**		
A*B	**11.639**			**3.084**			**10.560**			**4.563**			**1.666**		

Concentration of micronutrients

Referring to the data presented in Table (4), it could be observed that Fe, Mn, Zn and Co concentrations (mg/Kg) were increased significantly in broad bean seeds with different methods application and different rates of Zn, Co and their combination as compared with control. On the other hand, the results showed that in foliar application pronounced responses were obtained in the concentration of Fe by applying Zn_1, Co_2 and Zn_1Co_1 and recorded 76, 65.33 and 75.33 mg/Kg, respectively. While, for Mn concentration the highest values were recorded 16.0, 15.67 and18.0 mg/kg by applying Zn_1, Co_1 and Zn_2Co_2 and for Zn the values recorded 72.0, 54.66 and 60.33mg/kg by using Zn_1, $Co_1$the combined treatments Zn_2Co_1,as well as for Co the highest concentration were 1.13, 9.40 and 8.47 mg/kg when added $Zn_{2,}$ Co_2 and Zn_1Co_2. Concerning the effect of soaking method, the results reveal that the highest values for Fe were 68.0, 78.67 and 92 mg/kg by treating seeds with Zn_1, Co_1 and $Zn_1Co_{1,}$ respectively. AS for Mn concentrations the values recorded 16.33, 16.0 and 21.67 mg/kg with $Zn_{2,}$ Co_2 and combination of $Zn_1Co_1$and recorded and 21.67, respectively. While, for Zn concentration were achieved 68.33, 64.0 and 79.33 mg/kg with Zn_1, Co_2 and $Zn_1Co_{1,}$ respectively. Also for Co concentration the pronounced increase were obtained when added Zn_1, Co_2 and the combined Zn_2Co_2 treatments and recorded 0.6, 0.43 and 1.37 mg/kg, respectively. The data reported that the beneficial effect of the two levels of Zn and Co on mineral composition (N, P, K, Mn, Zn. and Co) of broad bean seeds in both seasons. The given results revealed that micronutrients concentration of the soaked treatments plants are relatively higher than those of the spraying treatments except Co concentration which seems opposite trend. Likewise, seed soaking with solutions of Zn-EDTA and flitted Zn improved yield arid Zn uptake; however, both sources differed in their efficiency to uptake Zn (Kang and Okoro, 1976). These results are in good agreement with those found by Jana *et al*. (1994) who stated that cobalt had a positive effect for better status of all mineral in groundnut seeds compared with the control. Basuet *et al*. (2004) added that cobalt gave superior nutrients uptake by groundnut seeds compared with control. On the other hand, these results are agree with (Blaylock *et al*., 1995) who stated that, cobalt addition in proportion significant reduction in iron content in soybean seeds. This indicates the competition between cobalt and iron. Confirm these results Nadia Gad (2006) indicated that addition of low Co level of 7.5 ppm had a significant promotive effect for better status of Mn. Zn and Cu in tomato plants. They added that a higher Co concentration has a hazardous effect. Anter and Nadia (2001) and Nadia *et al*. (2008) reported that responses associated with low cobalt levels may be attributed to catalase and peroxidase activities which were found to decrease with low levels of cobalt and increase with the higher ones. These enzymes are known to induce plant respiration. So superior resulting in successive consumption for products of photosynthesis and consequently reduced in planet growth. Concerning the effect of Co and Zn addition by different methods and rates on macro-micronutrients all cobalt treatments significantly increased nutrients status (except Fe content) and the chemical contents of broad bean seeds when compared with the control treatment. Concerning iron content in faba bean seeds, it took a contrary trend, where their values were significantly decreased by increasing cobalt levels from 5 ppm up to 20 ppm. All these data took the same trend of the content of macro and micronutrients in seeds of faba bean during the two seasons (Table 3&4). The obtained results of iron are in accordance with those found by Bisht (1991) and Blaylock *et al*. (1995), who showed certain antagonistic relationship between Co and Fe. Also, Atta Aly *et al*. (1991) found that cobalt and iron were competitive elements in the nutrition of tomato plants. These results were confirmed by Abdel-Moez and Nadia (2002) , who stated that Co content in tomato plants increased by increasing cobalt additions. Data in table (4) revealed that increase cobalt levels in plant media increased cobalt content in broad bean seeds compared with control treatment. These results clearly indicated that cobalt content goes along with the concentration of cobalt added. The obtained results are in good agreement with those obtained by Nadia *et al.* (2011) pointed that there was evidence that when plant roots absorb water, soil solution containing cobalt moves from the non-rhizosphere soil towards roots by mass flow. These results are in agreement with those obtained by Nadia Gad and Hala (2010) in wheat plants. From aforementioned results soaking treatment is a better option from an economical perspective as less micronutrient is needed, it is easy to apply and seedling growth is improved (Singh *et al.* 2003).

Table 4: Effect of zinc and cobalt applied with different methods and rates on N %, P % and K % of *Vicia faba* L. plant.

Treatments	N %			P %			K %		
	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)	Foliar	Soaking	Mean (B)
Control	2.35	2.92	2.64	0.32	0.31	0.27	1.26	1.40	1.33
Zn1	3.11	2.93	3.02	0.32	0.30	0.31	2.11	1.80	1.96
Zn2	2.66	2.70	2.68	0.25	0.28	0.26	1.54	1.66	1.60
Co1	3.11	2.91	3.01	0.32	0.27	0.30	1.98	1.42	1.70
Co2	2.86	3.05	2.96	0.28	0.32	0.30	1.80	1.87	1.84
Zn1Co1	2.87	3.15	3.01	0.27	0.30	0.28	1.48	1.91	1.70
Zn1Co2	2.90	3.04	2.97	0.29	0.32	0.30	1.75	2.04	1.90
Zn2Co1	2.84	3.05	2.95	0.28	0.25	0.27	1.77	2.0	1.86
Zn2Co2	2.98	3.18	3.08	0.28	0.30	0.29	1.63	2.00	1.76
L.S.DA	0.134			0.006			0.371		
B	0.209			0.026			0.259		
A*B	0.295			0.036			0.366		

Conclusion

From the above mentioned discussion of all considered parameters it could be concluded that irrespective of fertilization factor of soaking technique seems to be more efficient than the spraying one for higher yield of broad bean.

References

1. Abd-El-Moez, MR. and Sh. Nadia Gad (2002). Effect of organic cotton compost and cobalt application on cowpea plants growth and mineral composition. Egypt. J. Appl. Sci., 17:426-440.
2. Anter, F. and Nadia Gad (2001). Cobalt absorption in relation to plant water balance. Egypt. J. soil Sci., 41(1-2):111-122.
3. Atta Aly, M.A.; G. Nadia and T.M. El-Kobbia (1991). Effect of cobalt on tomato plant growth and mineral content. Annals Agric. Sci. Ain shams Univ., 36:617-624.
4. Atta-Aly, M.M. (1998). Soaking summer squash seeds in low concentration of cobalt solution before sowing increased plant growth, femaleness and fruit yield via increasing plant ethylene level. J. Plant Growth Rgul., 17, 25-32.
5. Basu, M, P.B.S. Bhadoria and S.C MahaPatra (2006). Influence of microbial culture in combination with micronutrient in improving the ground nut productivity under alluvial soil of India Acta agricultural slovenica, 87:435-444.
6. Berglund, DR. (2002). Soybean Production Field Guide for North Dakata and North Western Minnesota Published in Cooperative and with Support from the North Dakata Soybean Council.136 p.
7. Bisht, J.C. (1991). Interrelation between minerals plant tissues, iron and cobalt.Pescui, Agropecu. Bras.16:739-746.
8. Blaylock, A.D, T.D. Daivis, V.D. Jolly and R.H. Walser, (1995). Influence of cobalt and iron on photosynthesis, chlorophyll and nutrients content in regreeningchlorotic tomatoes and soybeans. Journal of plant Nutrition, 8:823-838.
9. Bozoglu, H.; Ozcelik, H.; Mut, Z.; Pesken, E. (2007). Response of chickpea (*Cicer arientinum* L.) to zinc and molybdenum fertilization. Bangladesh J. Bot., 36(2)145-149.
10. Cakmak, I. (2000). Role of zinc in protecting plant cells from reactive oxygen species. New Phytol., 146,185-205.
11. Carmen, M.A.; Carmen Z.J.; Salvador S.; Diego N.; Maria Teresa R.M.; Maria T. (2005). Detection for organic traits in faba bean (*Vicia faba* L.). Agric. Conspec.Scie., 70(3):17-20.
12. Chapman, T.D. and P.F. Pratt (1961). Methods of Analysis for Soil, Plant and Water. Agric. Publ. Univer. of California, Reverside.
13. Chatterjee, J. and Chatterjee, C. (2003). Management of phytotoxicity of cobalt in tomato by chemical measures. Plant Sci., 164:793-801.
14. Collins, R. and Kinsela, A. (2011). Pathogenic Factors and Measurements of The Plant uptake of Cobalt. Plant Soil, 339:499-512.
15. Diniz, K.A.; Silva, P.A.; Oliveira, J.A. and Evangelista, J.R.E. (2009). Sweet pepper seed responses to inoculation with microorganisms and coating with micronutrients, amino acids and plant growth regulators. Scientia Agricola, 66:293-297.
16. Duffy, B. (2007). Zinc and plant disease In. Mineral nutrition and plant disease, L. E. Datnoff, W.H. Elmer, and D.M. Huber,Eds.,155-175.
17. El-Fouly, M and A.A. Fawzi (1996). Fertilizer Use in the Near East Agriculture Over View. Regional Workshop on fertilizer use for Sustainable Agriculture. Amman. Jordon., 4-6.
18. Farooq, M.; Basra, S.M.A.; Wahid, A.; Khaliq, A. and Kobayashi, N. (2006). Rice seed invigoration. In:E.Lichtouse(ed.). Sustainable Agriculture Reviews, 137-175. Springer, the Netherlands.
19. Farooq, M.; Wahid, A. and Siddique, K.H.M. (2012). Micronutrients application through seed treatment. A review, Journal of Soil Science and Plant Nutrition,12:125-142.
20. FOtti, R.; Aburenie, K.; Tigere, A.; Gotosa, J. and Gere, J. (2008). The efficiency of different seed priming osmotic on the establishment of maize (*Zea mays* L.) Caryopses. J. Arid Environ., 72:1127-1130.
21. Geeth, R.H.M.; Mustafa, Y.M.M. and Abdel-Hakeem, W.M. (2013). Enhancing growth and increasing yield of pea (*Pisum sativum* L.) by application of ascorbic acid and cobalt chloride. Journal of Noval Applied Sciences. 2(4):106-115.
22. Hala K Handil. (2007). Effect of Cobalt fertilizer on Growth, Yield and Nutrients Status of faba bean (*Vicia faba* L.). Journal of Applied Sciences Research, 3(9):867-872.
23. Harris, D. Rashid, A.; Miraj, G.; Arif, M. Yunas, M. (2008). “On-farm” seed priming with zinc in chickpea and wheat in Pakistan, Plant Soil, 306:3-10.
24. Ibrahim, A.; S.O. El-Abd and A.S. El-Beltagy. (1989).

A possible role of cobalt in salt tolerance of plant. Egypt. J. Soil Sci., 359-370.

25. Jana, P.K.; S. Karmakar; S. Ghatak,; A. Barik; A. Naybri; G. Soud; A.K. Nukher and B.k. Saren. (1994). Effect of cobalt and rhizobium on yield, oil content and nutrients concentration in irrigated summer groundnut. Ind. J. Agric. Sci, 64:630-632.
26. Janmohammadi, M.; Dezfuli, P.M.; Sharifzadeh, F. (2008). Seed invigoration techniques to improve germination and early growth of in bread of maize under salinity and drought stress. General and Applied Plant Physiology, 4(33):215-226.
27. Kang, B.T. and Okora, E.G. (1976). Response of flooded rice grown on a vertisol from Northern Nigeria to zinc sources and methods of application. Plant Soil. 44, 15-25.
28. Kassab, O.M. (2005). Soil moisture stress and micronutrients foliar application effects on the growth and yield of mung bean plants. J. Agric. Sci., Mansoura Univ., 30:247-256.
29. Krishna, S. (1995). Effect of sulpher and zinc application on yield, S and Zn uptake and protein content of mung (green gram). Legume Res., 18:89-92.
30. Malakouti, MJ.;Tehrani, MH. (1999). Effect of micronutrients in yield increase and improvement of crops quality. Tarbiatmodarres University Press.
31. Marschner, H. (1995). Mineral Nutrition of Higher Plant, 2ndedn.Academic Press, London,U.K.
32. Mathur, N.; Singh, J.; Bohra, S.; Bohra, A. and Vyas, A. (2006). Effect of Soil Compaction Potassium and Cobalt on Growth and Yield of Moth Bean. International J. Soil Science, 1(3):269-271.
33. Mohandas, S. (1985). Effect of presowing seeds treatment with molybdenum and cobalt on growth, nitrogen and yield in bean (*Phaseolus vulgaris* L.) Plant Soil, 86,283-285.
34. Nadia Gad. (2006). Increasing the efficiency of nitrogen fertilization through cobalt application to pea plant. Research Journal of Agriculture and Biological Science. 2(6):433-442.
35. Nadia Gad, A.M. Shafie and M.S, Abdel-Fatah. (2008). Effect of cobalt on cucumber growth, fruits yield and mineral composition. J. Agric. Sci. mansoura Univ., 33(1):909-915.
36. Nadia G.; Aeshah, M.M. and Lyazzat, K. Bekbayeva. (2013 A). Response of cowpea (*VignaAnguiculata)* to cobalt nutrition. Middle-East J. of Scientific Research, 14(2):177-184.
37. Nadia Gad, Aeshah Mhana Mohammed and Lyazzat K. Bekbayeva. (2013 B). Role of cobalt on cowpea growth and yield under different levels of nitrogen. World Applied Sciences Journal, 22(4):470-478.
38. Nadia. G.; F.H.Abdel-Zaher; H.k. Abdel-maksoud and Abdel-Moez. (2011). Response of faba bean (*Vicia faba* L.) to cobalt amendments and nitrogen fertilization. The African J. of plant Science and Biotechnology, (5)1:41-45.
39. Nasef, M.A.; Nadia, M.P. and Amal, F.A. (2006). Response of peanut to foliar spray with boron and /or Rhizobium inoculation. Journal of Applied Sciences Research, 2(12):1330-1337.
40. Ozturk, L.; Yazici, M.A.; Yucel, C.;Torun,A.; Cekic, C.; Bagci, A. Ozkan, H.; Braun, H.J.; Sayers, Z. and Cakmak, I. (2006). Concentration and localization of zinc during seed development and germination in wheat. Physiol.Plant.,128:144-152.
41. Palit, S and Sharma, A. (1994). Effect of cobalt on plants. Bot. Rev., 60(2):149-181.
42. Palit, S.; Sharma, A. and Talukder, G. (1994). Effect of cobalt on plant. Bot. Rev., 60(2):149-173.
43. Potarzycki, J. and Grzebisz, W. (2009). Effect of zinc foliar application on grain yield of maize and its yielding components. Plant Soil Environ, 55(12):519-527.
44. Reddy, T. and Ray, S. (1975). Cobalt Nutrition of Groundnut in Relation to growth and yield. Plant Soil, 42:145-152.
45. Riley, I.I. and M.J. Dilworth. (1986). Cobalt in soil and plant. Micronutrients News and Information, 2:4-9.
46. Rauser, W.F. and Samarakoon, A.B. (1980). Vein loading in seedling of phaseolus vulgaris exposed to excess cobalt, nickel and zinc. Plant Physiol., 65:578-583.
47. Saber, Z.; Pirdashit, H. and Heidarzad, A. (2012). Osmopriming and hydropriming effects on seed and seedling parameters of two rapeseed (*Brassica napus* L.) cultivars. International Journal of Agriculture: Research and Review, 2(5):547-554.
48. Seifi Nader Gholi M.; Yarnia, M.; RahimzadKhoei, F. (2011). Effect of zinc and manganese and their application method on yield and yield components of common bean (*Phaseolus vulgaris* L. Cv. Khomein). Middle-East J. Sci. Res., 8(5):859-865.
49. Singh, B.; Natesan, S.K.A.; Singh, B.K.; Usha, K. (2003). Improving zinc efficiency of cereal under zinc deficiency. Curr. Sci., 88:36-40.
50. Singh, M.V. (2007). Efficiency of seed treatment for ameliorating zinc deficiency in crops. In: Zinc Crops 2007;Improving Crop Production and Human Health,24-26 May,2007,Istanbul Turkey.
51. Snedecor, G.W. and W.G. Cochran (1979). "Statistical Methods 7th ed. Iowa, State Univ.U.S.A.
52. Tewari, R.K.*et. al.* (2002). Modulation of oxidative stress responsive enzymes by excess cobalt. Plant Sci. 162:381-388.
53. Thalooth, A.I.; Tawfik, M.M. and Magda, H.M. (2006). A comparative Study on the Effect of Foliar Application of Zinc, Potassium and Magnesium on Growth, Yield and Some Chemical Constituents of Mung bean Plants Grown Under Water Stress Condition. World Journal of Agricultural Science, 2(1):37-46.
54. Tobbal, Y.F.M. (1999). Physiological studies on the effect of some micronutrients on growth and metabolism of some plants. M.Sc.Thesis, Fac. Sci. Al-Azhar Univ.
55. Yilmaz, A.; Ekiz, H.; Gultekin, I.; Torun, B.; Barut, H.; Karnalik, S. and Cakmak, I. (1998). Effect of seed zinc content on grain yield and zinc concentration of wheat grown in Zn-deficient soils. J. Plant Nutr., 21, 2257-2264.