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Response of Faba Bean (*vicia faba* L.) Productivity and Economic Evaluation to Cobalt

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Abstract:

Two field tests were done to assess specific periods of cobalt with various levels on the development, yield amount and nature of faba bean plants. The field tests were directed at Research and Production Station, National Research Center, EL-Noubaria under trickle water system framework, in two progressive periods of 2019 and 2020. Tests were led to assess the impact of cobalt (0, 6, 8, 10, 12 and 14 ppm) on faba bean development, yield amount and its quality. The acquired outcomes are showing that:
Applying cobalt in fixations for faba bean crop came about a critical expansion in the development, yield amount and quality contrasted and control. Cobalt at 12 ppm gave the best development , yield. Boundaries, minerals piece and synthetic constituents of faba bean. As cobalt level expanding in plant media over than 12 ppm , the positive impact was diminished.

Key words: Cobalt, Faba bean, Yield quantity, Economic, Quality.

Introduction

Faba bean is one of the main food vegetable harvests as a wellspring of plant protein and for its constitution in various famous heavenly Egyptian food. Additionally Faba bean could be collected in on youthful condition to be eaten and cooked as green bean.

Cobalt is fundamental for the combination of nutrient B12 which is needed for human and creature sustenance (youthful , 1983) . Smith (1991) tracked down that , with the expanding in age cobalt doesn't amass in human body as the other weighty metals

Jana et al (1994) showed that the better nodulation , development and yield of groundnut plants with Cobalt at 0.21kg/ha contrasted and control . Singh et al (1994) expressed that cobalt at 2 mg/kg soil gave the most noteworthy nodulation rate , development and yield of phaselus volgaris contrasted and untreated plants. Mathur et al., (2006) showed that cobalt is a fundamental part of cobalamin, which is required for exercises of a few proteins and co-chemicals and is answerable for arrangement of leghaemoglobin,involve in nitrogen obsession in knobs of leguminous plants. Younis (2007) showed that cobalt at 100 mg/kg soil expanded knobs number and their mass in (Lablab purpureus) plants. Nasef et al., (2008) found that cobalt at 15 ppm showed fundamentally higher knob number and weight, knob N focus, leghaemoglobin content, complete biomass creation and seeds yield of nut plants contrasted and untreated plants. Bhadoria (2008) detailed that dirt utilization of cobalt at lower portion (0.21 kg ha-1) with Rhizobium immunization had essentially improved nitrogen (81.4 kg ha-1), P (8.9 kg ha-1), K(9.31 kg ha-1) and cobalt (0.27 kg ha-1) take-up by part of groundnut Jaya kumar , et al (2009) showed that cobalt at 50 mg/kg soil signifi cantly expanded soybear development and biomass just as cases yied contrasted and conteol . Nadia Gad et al (2021) Found that the application cobalt at 12 ppm to both yard excrement and farming fertilizer came about the greates chickpea undulation rate , development and seeds yield amount and its quality. The principle objective of this undertaking is to feature on the job of cobalt various levels on the development and usefulness of faba bean.

Materials and Methods

Soil analysis:

Soil test was taken from Research and creation Station, Nobaria, Behiera Governorate, Delta Egypt. Such example was air dried and afterward ready for examination utilizing customary methods.

Actual analysis:

Molecule size appropriations, alongside dampness qualities and surface not set in stone as indicated by Blackmore (1972).

Compound investigation:

Electrical conductivity (ds/m-1), pH in soil-water suspension (1:2.5), natural matter substance (%), CaCO3 (%),cations and anions in meq/liter (in soil glue), large scale and still up in the air as indicated by Black et al., (1982).

Cobalt analysis:

Absolute still up in the air in Aqua regai remove (Cottenie, 1982). The water dissolvable cobalt just as accessible cobalt (DTPA extractable) was tested by Black et al., (1982). Assurance of cobalt was completed utilizing Atomic Absorption Spectrophotometer, Varian AA-20. Some physical and substance properties of Nubaria soil test are displayed in Table (1)

Table (1): Some physical and chemical properties of soil sampels which taken from El- Nubaria, Research and Production Station, National Research Centre

Physical properties											
Particle size distribution %				**Soil moisture constant %**							
Sand	**Silt**	**Clay**	**Soil texture**	**Saturation**	**FC**	**WP**	**AW**				
70.8	25.6	3.6	**Sandy loam**	32.0	19.2	6.1	13.1				
Chemical properties											
				Soluble cations ($meq^{-1}L$)				**Soluble anions ($meq^{-1}L$)**			
pH 1:2.5	**EC ($dS\ m^{-1}$)**	**CaCO3 %**	**OM %**	**Ca^{++}**	**Mg^{++}**	**K^{+}**	**Na^{+}**	**HCO_3^-**	**CO_3**	**Cl^-**	**$SO_4^=$**
8.49	1.74	3.4	0.20	0.8	0.5	1.6	1.80	0.3	0.0	1.9	0.5
Cobalt				**Total**	**Available**			**Available micronutriments**			
Ppm				**mg 100 g^{-1} soil**				**ppm**			
Soluble	**Available**	**Total**		**N**	**P**	**K**		**Fe**	**Mn**	**Zn**	**Cu**
0.35	4.88	9.88		15.1	13.3	4.49		4.46	2.71	4.52	5.2

FC (Field capacity), WP (Welting point), AW (Available water).

Plant materials and experimental work:

A fundamental investigation was directed at wire place of National Research Center , EL-Bohooth Streat , Dokki , Cairo , Egypt , to characterize diverse cobalt levels range which gave development and yield reaction of Lentil . As indicated by the fundamental examination results the focuses scope of cobalt which gave the faba bean reaction (0 ,6, 8,10,12 and 14 ppm).

All agrarian administration for plant development and creation were completed as suggested by Ministry of Agriculture

seed of faba bean (vicia faba var.Giza compassionate) were immunized before planting with a particular strain of rhizobium leguminosrum var.vacia preceding planted on october 2019 and 2020 ocean children under dribble water system framework (0,6,8,10, 12 and 14 ppm)

Estimations of nodulation and nitrogenase action:

Knobs number and weight will record following 50 days from planting. Nitrogenase not really settled by Hardy (1968). plants were tenderly evacuated then the root knobs were set in 500 ml serum bottles and were fixed with suba-seal rubbers and 10 % of the gas stage was supplanted by C2H2 then, at that point, bottles were brooded in dim at room temperature for 2hr. creation of C2H4 was estimated by infusing one ml gas test into (GC). Nitrogenase movement esteems were recorded as µmol C2H4/g/h.

Estimations of vegetative development:

Following 80 days from planting, all development boundaries of plants, for example, plant tallness root length, number of branches and leaves also shoot and root new and dry loads will record as per FAO (1980).

Estimations of plant yield:

Following 110-120 days from planting individually, yield boundary, for example, units number/plant, weight of cases/plant, weight of seeds/plant, 100 seeds weight, all out cases yield (kg/took care of), complete cases yield (Ton/took care of) will record as per Gabal et al (1984).

Estimation of sustenance status:

In seeds, macronutrients (N, P, K), micronutrients (Mn, Zn, Cu and Fe) alongside still up in the air as per Cottenie et al., (1982).

Estimation of compound constituents:

In seeds, absolute proteins, complete solvent sugars, starch and still up in the air as per A.O.A.C(1995).

Measurable examination:

All information were dependent upon measurable examination as indicated by system laid out by SAS (1996) PC program and means were contrasted by LSD strategy concurring with Snedecor and Cochran (1982).

Results and Discussion

Impact of various cobalt levels on development and yield creation of Faba Bean which filled in Research and creation Station , Noubaria Site , National Research Center.

Noduolation Parameters :

Information in Table (2) show that the all cobalt levels from 8 to 14 ppm gave knobs development contrasted and different medicines. Cobalt at 12 ppm came about the greastest nodulation pace of Faba bean and nitrogenase compound . As cobalt expansion in plant media more than 12.0 ppm ,knobs number,fresh and dry loads altogether diminished.

Table(2) : Effect of cobalt levels on noduolation of Faba bean after 50 days from sowing (Mean of tow seasons) .

Cobalt traments (PPM)	Nodules Number / plant	Nodules / plant (g)		Nitrogenase
		Fresh weight	Dry weight	
Control	46	4.30	1.26	18.2
6	55	5.51	1.63	19.9
8	67	5.96	1.81	21.6
10	73	6.45	1.97	23.4
12	85	6.93	2.19	25.3
14	80	6.64	2.03	23.7
LSD 0.05	4.8	0.18	0.6	0.4

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These outcomes are in agreement with those acquired by Mathur et al., (2006) who observed that cobalt is a fundamental part of cobalamin, which is required for exercises of a few catalysts and co-proteins and is liable for development of leghaemoglobin,involve in nitrogen obsession in knobs of leguminous plants. Nadia Gad et al., (2011) added that cobalt at 12 ppm essentially expanded knobs arrangement and increment nitrogen content in foundations of faba bean plants contrasted and different medicines.

Vegetative Growth:

Faba bean development boundaries as impacted by cobalt application are given in Table (3).Data show that all cobalt levels altogether expanded the development boundaries of Faba bean contrasted and untreated plants .Cobalt at 12 ppm had a most noteworthy upsides of Faba bean development boundaries.

Table (3): Effect of cobalt levels on growth parameters of Faba bean after 70 days from sowing (Mean of two seasons).

Cobalt traments (PPM)	Plant hight (Cm)	Number/plant		Fresh weight /plant		Dry weight /plant	
		Branches	Leares	Shoots	Roots	Shoots	Roots
Control	43.5	2.25	22.5	102.5	20.2	23.2	4.60
6	47.8	2.50	26.3	119.3	24.7	27.6	4.76
8	53.3	3.0	32.3	131.3	27.3	32.4	5.04
10	57.0	3.50	37.8	135.5	32.8	35.6	5.27
12	63.3	4.00	41.3	149.5	36.4	38.7	5.48
14	60.5	3.0	38.5	145.3	33.1	33.7	4.91
LSD 0.05	2.6	0.4	3.1	4.1	2.3	1.2	0.31

Obviously cobalt improves all development boundaries, for example, plant tallness, number of branches and leaves, just as new and dry loads of both shoot and root.When cobalt expansion expanded a bove 12 ppm the promotive impact of all development boundaries diminished. These outcomes are in congruity with those acquired by Balai et al., (2005) and Banerjee et al., (2005) who expressed that cobalt recorded the greatest leaf region file, dry matter gathering in shoot and root ,plant stature just as pods yield in both cowpea and groundnuts contrasted and control.

Yield qualities:

Acquired outcomes in Table (4) uncover that cobalt fundamentally further develop all yield boundaries, for example, units number per plant ,cases weight per plant and seeds weight per plant. All cobalt focuses altogether expanded Faba bean yield boundaries contrasted and control plants.

The most noteworthy record upsides of the referenced boundaries of Faba bean were gotten in plants treated with 12 ppm cobalt. Expanding cobalt level in plant media over 12 ppm the promotive impact diminished

Table (4): Effect of cobalt levels on yield characteristics of Faba after 120 days from sowing (Mean of two seasons) .

Cobalt traments (PPM)	Pods number/ plant	Pods weight/plant (g)	Pods Length (cm)	Seeds number/ pod	Seeds weight / plant	Seeds yeild (Ton/fed)
Control	17.9	315.8	10.2	3.19	44.03	1.21
6	20.3	353.3	10.8	3.81	52.60	1.52
8	24.2	400.5	12.7	4.70	60.12	1.63
10	27.4	436.8	14.0	4.86	68.52	1.79
12	30.9	452.3	15.3	5.23	74.62	2.03
14	27.4	430.3	13.6	5.09	71.23	1.83
LSD 0.05	2.3	1.6	1.4	0.13	2.67	0.31

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These outcomes are in acceptable concurrence with those got by Abdul Jaleel et al., (2009a,b) who tracked down that cobalt expansion in soil expanded all yield boundaries, for example, seedling power per plant,number and loads of cases and seeds yield per plant in green gram (vigna transmit L.) and maize (Zee maiz L.) plants . Affirm these outcomes Assian Minz et al., (2018) who expressed that utilization of cobalt through seed medicines works on the germination of vegetables seed medicines works on the germination of vegetables seed, starid foundation, development just as yield and quality Dietary status.

Nitrogen,Pand K substance

Information in Table (5) plainly demonstrate that Nitrogen, P and K substance: Obtained information unmistakably show that all cobalt rates gave the focus contrasted and untreated plants. Cobalt at 8 ppm treatment had a greatest substance of N, P and K in Faba bean seeds correlation with untreated plants. The outcomes uncover, true to form and as referenced by Abd El-Moez and Nadia Gad (2002) that cobalt at 8 ppm expanded macronutrients (N, P and K) content in the two shoots and foundations of cowpea plants.

Manganese, Zn, Cu and Co substance:-

Information in Table (5) demonstrate that all cobalt rates gave the focus contrasted and untreated plants cobalt at 12 ppm had a critical most elevated upsides of Mn, Zn, Cu and Co of Faba bean seeds contrasted and the untreated plants. These outcomes are in concordance with those detailed by Jayakumar et al(2018) who tracked down that all minerals sythesis of blackgram were expanded with cobalt at 50 mg/kg soil, when contrasted and the control.

Table (5) : Effect of cobalt levels on nutritional status of Faba bean pods (Mean of two seasons)

Cobalt treatments (PPM)	Macronutrients (%)			Macronutrients (ppm)				Cobalt (ppm)		
	N	P	K	Mn	Zn	Cu	Fe	Shoots	Roots	Seeds
Control	2.86	0.466	1.54	19.0	16.8	15.0	164	0.78	1.25	0.57
6	2.98	0.469	1.61	20.9	18.3	16.7	161	2.07	3.44	0.68
8	3.34	0.478	1.69	22.5	20.6	17.5	158	2.91	4.22	0.96
10	3.61	0.485	1.75	24.2	22.2	19.0	154	3.46	5.51	1.19
12	3.96	0.493	1.86	26.7	24.7	20.3	149	4.17	6.51	1.48
14	3.74	0.489	1.81	25.0	23.2	19.2	146	4.69	7.66	1.78
LSD 0.05	0.7	0.3	0.42	1.3	1.4	0.8	2.8	0.52	1.0	0.22

Iron substance:

The current information in Table (5) demonstrate that cobalt fundamentally decline iron substance in Faba bean seeds contrasted and the untreated plants. These outcomes are in concordance with those acquired by Angelove et al (1993) that, cobalt expansion in plant media showed moderate sorrow impact on iron status in tomatoes and soyabean plants. They added that specific adversarial connections among cobalt and iron.

Cobalt content

Information in Table (5) uncover that expanding cobalt levels in plant media expanded cobalt happiness in Faba bean seeds contrasted and control treatment. These outcomes unmistakably demonstrated that cobalt content obliges the convergence of cobalt added. The acquired outcomes are in acceptable concurrence with those got by Nadia Gad et al (2017) . El-kobbia and osman (1987)

pointed that there was proof that when plant roots retain water, soil arrangement containing cobalt moves from the non-rhizosphere soil towards roots by mass stream.

Compound Constituents

The measure of protein, absolute starch, complete solvent sugars and all out dissolvable solids rates in Faba bean seeds as impacted by cobalt are given in Table (11).Results show that every one of the referenced boundaries were fundamentally expanded by cobalt sustenance. Cobalt 12 ppm expanded all synthetic substance as a nature of Faba bean seeds. Expanding cobalt over 12 ppm results the downturn promotive impact.

Table (6): Effect of cobalt levels on chemical content of Faba bean pods which grown in Noubaria farm.

Cobalt traments (PPM)	Total Proteins	Total carbohydrates	Total Soluble Sugars	Vitamine (A) (M/100g)
	%			
Control	17.9	43.2	3.45	6.77
6	18.6	50.3	3.89	6.91
8	20.9	51.5	4.01	7.08
10	22.6	52.4	4.23	7.86
12	24.4	53.7	4.96	6.71
14	23.4	52.9	4.38	8.14
LSD 0.05	1.3	1.2	0.11	0.13

These outcomes are in agreement with those got by Nadia Gad (2012 C) uncovered that cobalt expansion in plant media expanded protein, complete solvent solids, all out carbs and absolute dissolvable sugars in groundnut seeds.

Economic evaluation of the Cobalt element:

Evaluating the cobalt element from an economic view requires the definition of "production efficiency", which is the ability to produce the largest number of units produced using the least possible amount of available resources, with the aim of achieving a balance between resource use, production rate and quality of the goods being produced. Production Efficiency it is not possible to produce more goods without using additional resources, and thus the “Allocative Efficiency” is achieved, which in turn achieves the welfare of society.

Production efficiency has two meanings: Technical Efficiency and Economic Efficiency. Technical efficiency in production is achieved when a certain amount of production is obtained using the least amount of production factors, or when maximum production is obtained using a certain amount of resources. While economic efficiency is intended to achieve a certain amount of production at the lowest possible costs.

First: Technical efficiency:- It can be demonstrated by studying the effect of using the cobalt element on each of the fadden productivity and rationalizing the consumption of the water element. The data of Table No. (7) indicates that the use of cobalt resulted in an increase in the productivity of the Faba Bean crop, with an estimated increase of 67.76 % compared to the control, which amounted to about 1.210 tons / fadden. The element using also resulted in the rationalization of the amount of irrigation water needed to produce a ton of lentil crop by about 40.42%, the water needs for producing an Fadden of Faba Bean crop are about 1258 m3.

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Table No. (7): The effect of cobalt on the productivity of the Faba Bean crop

Statement	The effect on the productivity of the Fadden		Statement	The effect on the amount of irrigation water	
	control	cobalt		control	cobalt
Fadden productivity per/ ton	1.210	2.030	Amount of water ton/m^3	1039	619
Amount of increase in production/ in tons	-	0.820	Quantity of water conservation ton/m^3	-	420
% increase in production	-	67.76	% decrease in irrigation water	-	40.42

Source: from project data , http://www.capmas.gov.eg

Second: Economic efficiency:- It can be demonstrated by studying the cost of production per Fadden and some indicators of economic efficiency.

- The relative importance of the Fadden production costs of the Faba Bean crop:-

Table (8) shows that the cost of producing an Fadden of Faba Bean crop is about 10441 pounds, and the rental cost accounts for the largest percentage of the total costs by about 39.08%, followed in importance by the cost of seeds and cultivation, harvesting and Land Preparation by about 9.72%, 9.29%, 7.30% for each of them, respectively, as shown in the aforementioned table.

Table No. (8): Costs of producing an Fadden of Faba Bean crop

Statement	**EGP value**	**%**
Land Preparation	762	7.30
Seeding & Planting	1015	9.72
Irrigation	615	5.89
Fertilization	735	7.04
Weeding	685	6.56
Pest Control	488	4.67
Harvesting	970	9.29
Transportation	513	4.91
Other Expenses	578	5.54
Rent	4080	39.08
Total costs	10441	100

Source: Arab Republic of Egypt, Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Part One, Winter Crops 2019.

- Indicators of economic efficiency:-

It can be known by studying the effect of using the cobalt element in the cultivation of the Faba bean crop on each of the cost of producing a ton, the yield of producing a ton, and the rate of return on costs. Where the data of the table ( ) indicates that the use of cobalt in the cultivation of the Faba bean crop has many positive effects affecting the economic indicators under study,

as it was shown that the cost of producing a ton of the crop decreased by about 3186 pounds, with a decrease of about 36.92%, and an increase in the return on the invested pound To produce a ton by about 0.749 pounds, an increase of about 51.62 %, compared to the control as shown in the table.

Table No. (9): The effect of using cobalt on some indicators of faba bean economic efficiency

Faba Bean crop	**control**	**cobalt**	**drop value**
Production cost per ton	8629	5443	3186
The cost of using cobalt to produce a ton in pounds	-	247	-
Total production costs in pounds	8629	5690	2939
total revenue per ton	12520	12520	-
Investor's Return	1.451	2.200	0.749

Source: Arab Republic of Egypt, Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Part One, Winter Crops 2019 , project's data .

The expected economic effects from the generalization of the use of cobalt in the cultivation of the Faba Bean crop:-

Table No. (10): The effect of generalizing the use of cobalt in the cultivation of faba bean on the import bill

Statement	control	cobalt
Fadden productivity / ton	1.210	2.030
The target area / thousand Fadden	702	420
Total production quantity / thousand tons	849	853
The total import value is one million dollars	4618	4639
% decrease in import value	100	100

Source: https://www.un.org, project data

To face the consumption needs of the Faba Bean crop, Egypt relies on importing about 0.850 million tons of the Faba Bean crop, with imports value about 4623 million dollars, as this imported quantity needs about 702 thousand Fadden's to produce about 849 thousand tons, which contributes to covering the size of the food gap from the crop , If the results of the project are applied to generalize the use of cobalt in the cultivation of the Faba Bean crop, it will need about 420 thousand Fadden's to produce about 0.853 million tons, which will contribute to covering the food gap of the bean crop, thus reducing the value of the Egyptian import bill of the bean crop by 100%, and this space can be saved from the area targeted for cultivation by the Egyptian state, estimated at 2.5 million Fadden's, as shown by the table data (10)

Conclusion:

Cobalt is a fundamental component to vegetables, for example, Faba bean. Cobalt is promising component in the recently recovered soils . Consequently significant consideration ought to be taken concerning applying this component (Cobalt) incorporate the fundamental supplements of plants

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