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Effect of ferrous sulphate with and without organic matter on growth, yield and nutrients content of Chickpea *(Cicer arietinum L.).*

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Abstract : Pot experiments were conducted at National Research Centre Greenhouse, Giza, Egypt to study the effect of ferrous sulphate (0, 3 and 6 g L^{-1}) without or with (20 ton per Fadden) farmyard manure on growth parameters, yield parameters and nutrient status of chickpea.

The obtained results indicate that:

* Application of ferrous sulphate at a rate of 6 gL^{-1} without or with organic matter increased the plant height about 31.7% and 28.2% and number of branches per plant about 13.2% and 30.9% as compared with control.

***** The highest value of protein and oil percentage recorded (24.1 %, 7.0% respectively) at 6 g L-1 ferrous sulphate with organic matter in chickpea seeds.

***** All the organic treatment increased growth parameters, yield parameters, macronutrient and micronutrient content in chickpea seeds.

Keywords: Chickpea- ferrous sulphate- farmyard manure-nutrient statues.

Introduction

Chickpea *(Cicer arietinum L.)* is an important crop in the Mediterranean area, offering high-quality protein and increasing impute of combined N_2 into the soil. In this region, the chickpea has been traditionally used in rotation with cereal crops, and the benefits of these practices are well known [1]**.** However, salt sensitivity can adversely affect yield in this crop. Although the effect of salinity on growth, nodulation and N fixation of this species has been studied [1, 2,3,4]**,** little is known of the physiological and biochemical responses of chickpea to salt stress concerning such aspects as photo synthesis, ammonium assimilation or compatible solute accumulation.

Chickpea is grown in tropical, sub-tropical and temperate regions, with different varieties sown according to the various climates. Kabuli type is grown in temperate regions while the desi type chickpea is grown in the semi-arid tropics [5]**.**

Organic composts can improve soil-water-plant relations through modifying bulk density, total porosity, soil water relation and consequently, increasing plant growth and water use efficiency [6,7]. Addition of organic manure to sandy soil enhance microbial activity and increase their ability to conserve fertigation and consequently increasing their fertility and fertilizers use efficiency as a final goal [8]**.** Increase soil organic matter will increase the amount of nutrients and the ability of the soil to make those nutrients available for plants [9,10]**.** **Anant-Bahadur *et al*** [11] pointed that organic matter plays an important role in the chemical behaviour of several metals in soils throughout its active groups (flavonic and humic acids) which have the ability to retain the metals in complex and chelate forms**.** Also, organic manure enhances soil aggregation, aeration, water

holding capacity and amended the root system by slow flow of nutrients which in combination creates favourable conditions for root respiration, nutrients absorption, growth and yield quality and quality of Broccoli and tomato [12, 13]**.**

Ferrous is an immobile element; therefore, its deficiency is evident in young leaves. It is quite necessary in chlorophyll synthesis, hydrocarbon production, respiration, as well as oxidation and reduction operations in plants. Ferrous rate varies from 400 to 200 ppm in plant tissues. However, its rate must be more than 100 ppm in healthy plants. Its main sign is chlorosis usually seen in young leaves [14]. Ferrous deficiency has developed in almost 30 percent of the soils under cultivation around the world [15]**.** In addition, ferrous absorption decreases in the soils with law organic matters [16].

Material and Method

Soil analysis:-

Soil samples were collected from Research and Production Station, National Research Centre in El-Nubaria. Pot experiments were conducted in the greenhouse of the National Research Centre. Some physical and chemical of the used soil are shown in Table (1).

Particle size distributions along with soil moisture were determined as described by **Blackmore**[17]**.** Soil organic matter, $CaCO_3$, EC, pH, cation and anions, soluble and available macronutrients and micronutrients were determined according to **Black *et al.*,** [18] **and Cottenie et al.,** [19]**.**

Table (1): Some physical and chemical properties of the used soil at El-Nubaria, Research and Production Station, National Research Centre.

Soil property	**Particle size distribution %**				**Soil moisture constant %**			
Physical	**Sand**	**Silt**	**Clay**	**Texture**	**Saturation**	**FC**	**WP**	**AW**
	68.7	24.5	6.8	sandy loam	**%**			
					23.0	19.2	6.1	13.1
chemical	**pH[a]**		**EC[b] dS/m**		**$CaCO_3$%**		**OM [c]%**	
	7.8		0.18		7.07		0.16	
	Soluble cations (meq/l)				**Soluble anions (meq/l)**			
	Ca^{++}	**Mg^{++}**	**K^{+}**	**Na^{+}**	**$CO_3^{=}$**	**HCO_3^{-}**	**Cl^{-}**	**SO4**
	3.00	2.00	0.32	2.09	0.00	1.41	0.70	5.30
	Total		**Available**		**Available micronutrients**			
	N		**P**	**K**	**Fe**	**Mn**	**ZN**	**Cu**
	mg/100 g soil				**ppm**			
	15.0		9.4	16.0	7.8	3.3	1.86	4.0
					Cobalt (ppm)			
					Soluble	Available	Total	
					0.49	4.43	15.00	

a: Soil pH was measured in 1:2.5 soil-water suspension, b: EC was measured as dSm^{-1} in soil paste extract,

The basic amounts of mineral fertilizers were 15 kg/fed ammonium nitrate (33% N), 150 kg/fed super phosphate (15.5 % P_2O_5) and 50 kg/fed potassium sulphate (48% K_2O). Ferrous sulphate rates (0, 3 and 6 g L^{-1}) and Farmyard manure was added at 20 (Ton/fed). Some properties of the compost are presented in Table (2).

Table (2): Some properties of organic compost used in the experiment.

Organic source	O.M %	Total N %	C/N ratio	pH (1:2.5)	EC dSm^{-1}	Available nutrients %		DTPA- extractable (ppm)			
						P	K	Fe	Mn	Zn	Cu
farmyard manure	36.00	1.8	17.07	7.5	3.3	1.20	1.6	840	30.0	15.0	3.0

The experimental design was factorial experimental in complete randomized with three replicates in plastic pots, 10 kg capacity of air dried soil in National Research Centre Greenhous. Seeds of chickpea *(Cicer arietinum L.)* Giza 1 which was previously inoculated with the specific strain of chickpea *Rhizobia* (Okadin). Two plant in each pot.

All the plant analyses were determined using the standard method described by **A.O.A.C.** [20]**; Jackson,** [21] **and Gabal *et al.*,** [22]**.**

All data were subjected to statistical analysis according to procedure outlined by **Snedecor and Cochran** [23]**.** Treatment means were compared by L.S.D test**.**

Results and Discussion

Effect of ferrous sulphate with and without organic matter on growth parameter are illustrated in Table (3).

Table (3): Effect of ferrous sulphate without or with compost on growth parameters of chickpea plant.

Treatment of $FeSO_4$ ($g\ L^{-1}$)	Plant height (cm)	No. of branches /plant	Fresh weight (gm/ Plant)	Dry weight (gm/ Plant)
Without organic matter				
0	26.2	3.8	6.9	2.4
3	28.7	4.1	10.0	3.5
6	34.5	4.3	16.7	5.8
Mean	29.8	4.1	11.2	3.9
With organic matter				
0	38.6	4.2	12.1	4.2
3	43.1	4.6	15.3	5.3
6	49.5	5.5	19.2	6.7
Mean	43.7	4.8	15.5	5.4
LSD 5%	1.24	0.11	0.91	0.21

Data observed that application of ferrous sulphate at different rates with or without organic matter significantly increase the plant height, number of branches per plant, fresh weight per plant and dry weight per plant. Application of ferrous sulphate at a rate of 6 gL-1 without or with organic matter increased the plant height about 31.7% and 28.2% and number of branches per plant about 13.2% and 30.9% as compared with control. Application of organic matter at 20 kg per fed increased means of fresh weight and dry weight 38.4% and 38.5%. These results are in harmony with the results obtained by Gobarah et al., [24] and Hala Kandil [25.]

Data recorded in Table (4) revealed that all studied of yield parameters significantly affected by ferrous sulphate without or with organic matter compared with the control treatment in both growing seasons. Data also showed that the highest values of weight seeds per plant (g), weight of 100 seeds (g), yields of seeds kg per Fadden, protein percent and oil percent. The highest value of protein and oil percentage recorded (24.1 %, 7.0%

respectively) at 6 g L-1 ferrous sulphate with organic matter in chickpea seeds. The same results reported by Hala Kandil [25]**,** she obtained that the Peanut compost application with sulphur enhances all yield parameter of onion.

Table (4): Effect of ferrous sulphate without or with compost on yield parameters of chickpea.

Treatment of $FeSO_4$ ($g\ L^{-1}$)	Weight of seeds /plant (g)	Weight of 100 seeds (g)	Yield Kg per Fadden	Protein %	Oil %
Without organic matter					
0	28.95	24.52	810.60	18.09	3.2
3	31.82	25.11	890.96	19.19	3.8
6	34.53	30.43	966.84	20.69	4.2
Mean	31.77	26.69	889.47	19.32	3.7
With organic matter					
0	34.71	34.31	971.88	21.30	4.1
3	36.18	35.91	1013.04	22.78	5.3
6	40.11	36.74	1123.08	24.10	7.0
Mean	37.00	35.65	1036.0	22.73	5.5
LSD 5%	1.65	1.73	15.43	1.13	0.01

Also, Gobarah et al., [24] showed that application of organic matter at 20 kg per Fadden increased grain yield and quality of barley significantly.

Generally, application of ferrous sulphate increases N, P, K, Fe, Mn, Zn and Cu content in seeds of chickpea**.**

Table (5): Effect of ferrous sulphate without or with compost on macronutrient and micronutrient content in seeds of chickpea.

Treatment of $FeSO_4$ ($g\ L^{-1}$)	Macronutrient (%)			Micronutrient (ppm)			
	N	P	K	Fe	Mn	Zn	Cu
Without organic matter							
0	8.08	0.232	0.885	128	57.3	33.2	8.9
3	8.57	0.236	0.896	136	58.1	33.9	9.2
6	9.24	0.241	0.952	143	59.4	34.5	9.6
Mean	8.63	0.236	0.911	135.7	58.3	33.9	9.0
With organic matter							
0	9.51	0.238	0.895	129	57.9	33.4	9.1
3	10.17	0.249	0.946	145	58.6	34.2	9.7
6	10.76	0.257	0.993	153	59.9	34.9	10.3
Mean	10.15	0.248	0.945	142.3	58.8	34.2	9.7
LSD 5%	0.16	0.003	0.004	1.33	0.24	0.21	0.16

Data in Table (5) show the effect of ferrous sulphate rate on mineral composition of chickpea seeds. All ferrous sulphate treatments can be arranged in decreasing order as follows: 6 gL^{-1} with compost > 3 gL^{-1} with compost > 6 gL^{-1} without compost. The highest nutrients content of chickpea seeds were obtained by the rate at 6 gL^{-1} with compost while the level of 0 gL^{-1} without compost gave the lowest ones. The observations are in consistent with previous reports obtained by Hala Kandil [25] who found that humic acid enhanced nutrient content in pea plant. Data in Table (5) also indicate that, compost treatments have a significant positive effect on chickpea seeds minerals concentration compared with control. Ferrous sulphat at 6 gL^{-1} with compost gave the greatest values of macronutrients (N, P and K) (10.76, 0.257 and 0.993 %) and micronutrients (Fe, Mn, Zn and Cu) (153, 59.9, 34.9 and 10.3 ppm) respectively. These results of macronutrient and micronutrient content are in agreement with those obtained by Hala Kandil [25]**.**

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