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INTERACTION BETWEEN IRRRIGATION WITH SEWAGE WATER AND ZINC FOLIAR APPLICATION ON FABA BEAN YIELD

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Abstract

A field experiment on faba bean (Vicia Faba) was conducted at Abu-Rawash Experimental Station, Giza. Treatments were three irrigation intervals (4, 6 and 8 days) with sewage water and three concentrations of zinc (0 , 0.4 and 0.8%) as zinc sulphate.

Crop production showed a high response by using sewage water for irrigation. Both straw and seed of faba bean were significantly increased by decreasing the intervals between irrigations, i. e. the yield took the following order : 4 >6 > 8 day. In addition, irrigation on every 4 days and 0.04% Zn SO_4 solution gave the best yield of faba bean (1.908 tons seed/feddan and 8.860 tons straw/feddan). This clarifies that the moisture content of sandy soils is the most important factor for their productivity.

INTRODUCTION

Egypt lies in arid and semi-arid regions. Most of our area for agricultural expansion is sandy soils which have poor physical properties, especially, low water retention. One of the ways to overcome the increasing of population in Egypt is to cultivate these soils. Sewage effluents, which are rich in organic materials and nutritional elements, are disposed in the big cities of Egypt about (4 millions of cubic

meters daily from Cairo City only). Some of these effluents are used for irrigating sandy soils.

Some investigators have attempted to express the effect of sewage water on the properties of sandy soils and the response of plants to its nutrients. (Johnson *et al.*, 1974). Brodford *et al.* (1975) revealed that the availability of micronutrients for plants was affected by many soil factors such as soil pH, soil texture, mineralogical composition, organic matter and carbonate content. Ibrahim (1980) also showed that increasing pH (more than 6.5) and carbonate contents resulted in decreasing the solubility of Zn in salt affected soils. Moreover, in sandy soils, the high infiltration takes the soluble nutrients deeper far away the rootzone. For these unfavorable factors many researchers used foliar application of micronutrients on plants. (El-Sharkweer *et al.*, 1982; Mona and El-Talisy 1985).

The purpose of this work is to study the effect of foliar application of Zn and irrigation intervals on faba bean yield and the properties of sandy soils.

MATERIALS AND METHODS

A field experiment was conducted at Abu-Rawash Experimental Station where sewage water is used for irrigation. The area of experiment was divided into three main plots representing three treatments of irrigation. Water was supplied at the three different intervals 4,6 and 8 days. Each main plot was divided into three sub plots each was 1/100 of a feddan. The plots were prepared to be planted with faba bean in rows. Each subplot consisted of eight rows and the distance between plant was 20 cm. The plants were thinned after a month from planting to leave 2 plants only in each hill. Within these main irrigation treatments three sub-treatments were established to which Zn was applied foliarly at the concentrations 0, 0.4 and 0.8% as zinc sulphates. The volume of the zinc sulphates solution applied to each plot was four liters. The solution was applied at two stages of growth; the first was directly after thinning; i.e. after one month from planting, and the second was after two months. Each treatment was replicated four times.

Two composite soil samples were collected from the whole area before starting the experiment representing two depths; 0-10 and 10-40 cm. At the end of the experiment soil samples were collected from the main plots of irrigation treatments

at the same depths. Also, representative sample of sewage water was taken for analyses.

Samples were analysed for particle size distribution, CaCO3 content, organic matter, water soluble salts, pH and soluble zinc according to Piper (1950), Jackson (1958) and Bredford *et al.* (1975). At maturity, both straw and seed yields of faba bean were determined. The results were statistically analysed.

RESULTS AND DISCUSSION

1. Changes in physico-chemical properties of sandy soils as affected by irrigation with sewage water

Data in Table 1 show that there is no distinct changes in sand fractions of the studied soil layers. However, the fine fractions slightly increased in the surface layers especially in case of irrigation every four days.

This is mainly due to the suspended material which was added with sewage water. Also, irrigation with sewage water caused a slight increase in soil content of organic matter. The highest values were observed in case of 4-day irrigation in terval. The same result was found by Hinesly *et al.* (1977). Concerning CaCO3 content there is no clear change in the different soil layers at all irrigation intervals. Data in Table 2 reveal that the pH values decreased from 7.4 to 6.3 in the surface soil layers which could be due to the effect of free organic acids in the sewage water (El-Shabassy *et al.* 1971 and Wisnieske *et al.* 1985). On the other hand, irrigation with sweage water caused marked changes for both cations and anions. However, this did not result in any salt accumulation due to the high availability of the NPK present in the sewage water.

2. Straw yield of faba bean :

Data in Table 4 show that the straw yield was affected by irrigation intervals. The maximum yield was observed at 4-day interval, while the minimum was at 8 day interval. In other words, straw yield under different irrigation intervals took the following order : 4 > 6 > 8 days.

Table 1. Particle size distribution, $CaCO_3$ and O. M. content in the studied soils as affected by irrigation with sewage water.

Irrig. interval with sewage water (day)	Depth in cm	Particle size distribution %				$CaCO_3$ %	O. M. %
		Coarse sand	Fine sand	Silt	Clay		
0	0-10	66.79	30.80	1.61	0.80	0.30	0.50
	10-40	64.63	33.12	1.40	0.75	0.43	0.45
4	0-10	64.14	31.92	1.44	2.50	0.28	1.10
	10-40	63.50	33.43	1.27	1.80	0.25	0.85
6	0-10	65.60	30.71	1.48	2.21	0.28	0.95
	10-40	65.10	31.93	1.27	1.90	0.26	0.82
8	0-10	66.12	30.60	1.13	2.15	0.27	0.70
	10-40	64.50	33.05	1.25	1.20	0.32	0.62

Table 2. Some chemical analysis of the studied soils as affected by irrigation with sewage water (1:5 soil : water extract).

Irrig. intervals with sewage water (day)	Depth in cm	pH	T.S.S. %	Soluble ions me q / 100 g soil							
				$CO_3^{=}$	HCO_3^{-}	Cl^{-}	SO_4^{-}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}
0	0-10	7.40	0.14	nil	0.63	0.72	0.98	1.40	0.38	0.50	0.05
	10-40	7.35	0.15	nil	0.60	0.75	1.05	1.40	0.40	0.55	0.05
4	0-10	6.80	0.22	nil	1.22	0.65	1.47	1.56	0.91	0.75	0.12
	10-40	6.75	0.16	nil	0.88	0.45	1.07	1.14	0.66	0.52	0.08
6	0-10	7.10	0.20	nil	0.90	0.76	1.40	1.62	0.63	0.74	0.07
	10-40	7.05	0.14	nil	0.62	0.73	1.12	1.35	0.40	0.65	0.07
8	0-10	7.10	0.18	nil	1.00	0.50	1.20	1.28	0.74	0.58	0.10
	10-40	6.90	0.11	nil	0.40	0.30	0.92	0.74	0.47	0.35	0.06

Table 3. Some chemical analysies of sewage water used for irrigation.

Location	pH	E.C. mmhos / cm	O.M %	Soluble - Zn ppm
Abu-Rawash Farm	6.47	1.10	0.032	1.40

Table 4. Straw yield of faba bean (tons/feddan) as affected by Zn application and irrigation intervals.

Zinc treatment	Irrigation intervals (days)			Mean values
	4	6	8	
0.0	7.28	5.93	3.55	5.58
0.4% Zn SO_4	8.86	7.12	3.94	6.64
0.8% Zn SO_4	6.27	5.30	3.24	4.93
Mean	7.46	6.11	3.58	

L.S.D. 0.05 for irrig. intervals 0.44
L.S.D. 0.05 for Zn additions 0.46
L.S.D. 0.05 for interaction (Zn x irrig.) 2.45

Table 5. Seed yield of faba bean (tons/feddan) as affected by zinc application and irrigation intervals.

Zinc treatment	Irrigation intervals (days)			Mean
	4	6	8	
0.0	1.55	1.35	0.85	1.25
0.4% Zn SO_4	1.91	1.59	1.05	1.52
0.8 % Zn SO_4	1.38	1.24	0.77	1.13
Mean	1.61	1.39	0.89	

L.S.D. 0.05 for irrigation intervals 0.06
L.S.D. 0.05 for zinc additions 0.06
L.S.D. 0.05 for interaction (Zinc x irrig.) 2.11

Regarding the effect of zinc application on straw yield, Table 4 shows a significant difference at 0.4% of Zn but there are no significant differences under all irrigation treatments at 0.8% of Zn. This result may be due to the high Zn concentration (0.8%) which may inhibit the uptake of other nutrients that affect the growth of faba bean plants.

Concerning the interaction between zinc concentrations and irrigation intervals on the straw yield, the most profitable treatment is, irrigation every 4 days and 0.4% of $ZnSo_4$ under the experimental conditions.

3. Seed yield of faba bean :

It is clear from Table 5 that seed yield took the same trend of straw. There was a significant decrease of seed yield by increasing irrigation intervals. The highest value of seeds was observed at 4-day irrigation interval and the lowest was at 8 day interval. Also, the best result of seed yield was at 4-day interval with 0.4% Zn SO_4.

These results indicate that the limiting factor for faba bean yield in sandy soils is the irrigaton intervals. In other words, the available water in sandy soils is very important for plant growth.

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أثر التسميد الورقى بالزنك والرى بمياه المجارى على خواص التربة ومحصول الفول البلدى بمنطقة أبى رواش

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أقيمت التجربة بمحطة البحوث بأبى رواش بالجيزة واستخدم فيها عنصر الزنك فى صورة كبريتات زنك بتركيزات صفر، ٤ر ، ٨ر ٪ رشا على الأوراق تحت معاملات رى مختلفة حيث كان الرى على فترات كل ٤ ، ٦ ، ٨ يوما بهدف دراسة أثر هذه المعاملات على محصول الفول البلدى وخواص التربة.

وأظهرت النتائج أن هناك نقص معنوى فى كل من محصول القش والبذور بزيادة الفترة بين الريات - وكان أحسن محصول سواء القش أو البذور تحت تركيز ٤ر ٪ زنك وفترة الرى كل ٤ أيام بينما نقص المحصول باستخدام التركيز العالى للزنك ٨ر ٪ تحت جميع معاملات الرى، كذا أوضحت النتائج أن المحصول (القش أو الحبوب) كان مرتفعا تحت معاملة الرى كل أربعة أيام يليه محصول الرى كل ستة أيام ثم الرى كل ثمانية أيام تحت جميع معاملات الزنك - وهذا يدل على أن الماء الميسر للنبات فى الأراضى الرملية عامل هام فى إنتاجيتها.