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SELENIUM PRESENCE AND BEHAVIOUR IN SOIL AND PLANT:
1- Se IN GIZA GOVERNORATE, EGYPT.

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ABSTRACT

Thirty six surface soil samples and the same number of plant samples of Egyptian berseem (*Trifolium alexandrinum*) (2nd cut), parsley (*Petroselinum crispum* Mill) and rocket (*Eruca vesicaria* L.) plants from twelve sites from Giza governorate were collected in January 2001; i.e three plant samples with their three soil samples from each site. Soil available Se was extracted using AB-DTPA. Soil and plant Se was measured spectrophotometerically.

The results showed that the soils of Giza governorate are relatively low $CaCO_3$, medium salinity level and relatively high clay content. The average values of dry weight percent for berseem, parsley and rocket were 10.56, 6.24 and 6.65%. The values of available Se are very low (the averaging equal 0.013 $\mu g.g^{-1}$) and correlated more or less negatively with soil EC. The average values of Se concentration in berseem, parsley and rocket plants are 0.083, 0.045 and 0.038 $\mu g.g^{-1}$. Thus, available Se positively and significantly correlated with Se in berseem, parsley and rocket plants, where the correlation coefficient values are 0.632*, 0.607* and 0.603* respectively. Thereafter, a linear regression behaviour could be found between available Se and those of berseem, parsley and rocket.

INTRODUCTION

One of the primary biochemical actions of Se in man occurs at the active site of glutathionc proxidase. This enzyme protects the cells and tissues against peroxidation. Stresses such as forced exercise, exposure to radiation and prooxidants, high intakes of dietary fats, and infectious diseases are believed to increase the production of free radicals, resulting in a need for increased intakes of nutrients such as Se and vitamin E with antioxidant effect (Gissel-Nielsen *et al.* (1984). The minimum human requirement is about 30 $\mu g.day^{-1}$ according to epidemiological studies made in china, where no Keshan disease type was found when the dietary Se exceeded 30 $\mu g\ day^{-1}$ (Keshan Disease Research Group 1979). The nutritional minimum level for animals and human is about 0.05-0.10 $\mu g.g^{-1}$ Se in dry fodder/food, and intake below that might cause severe deficiency diseases. Toxic effects of Se occur with exposure to levels of 2-5 $\mu g.g^{-1}$ Se or more, depending on the chemical form of the Se, (Levander, 1982b). The National Research Council (1980a) considers that 2 mg Se kg^{-1} DM is the maximum concentration tolerable for all species.

Perry *et al.* (1976) found a deficiency limit of 0.02 µg Se ml^{-1} in plasma, which corresponds to 0.056 µg Se ml^{-1} in total blood. Maus *et al.* (1980) showed that milk Se increased linearly with a dietary increase up to a certain level. El-Awag (1989) reported that soil a vailable Se extracted by DTPA ranged from 0.018 to 0.09 $\mu g.g^{-1}$ with average of 0.054 $\mu g.g^{-1}$ and Se concentration in Egyptian clover plants varied from 0.3 to 0.088 $\mu g.g^{-1}$ indicate

a potential dificient in Egyptian clover fodder to animals. Abdalla (1983) mentioned that selenium content in berseem ranged from 0.046 to 0.232 µg. g^{-1}. In many locations Se content is considered insufficient to meet animal requirments (less than 0.1 µg.g^{-1} Se).

Selenium can be present in the soil as selenides (-2), elemental selenium (0), selenite (+4), selenate (+6), and as organic compounds, predominantly in the reduced oxidation state (-2). The availability of Se differs strongly among these forms of Se. The Se concentration in most soils is not especially low, but on neutral to acid mineral-soils with relatively high contents of iron and organic matter, the Se is fixed strongly in the soil. Therefore, the plant availability is very low, and the release of Se to the soil solution is slow, (Gissel-Nielsen et al, 1984).

The average production of five years (1996-2000) of bersem, parsley and rocket in Giza governorate represented 3.9, 73 and 37% of the total production in Egypt, (Economic Affairs Sector, 1996-2000).

The objective of this work is to throw light on presence and behaviour of Se in the soil and some plants in Giza governorate (Egyptian bersem, parsley and rocket).

MATERIALS AND METHODS

Twelve sites were chosen in giza governorate represented twelve villages areas. Three surface soil samples (0-20 cm) and three plant samples (shoot part) of Egyptian berseem (*Trifolium alexandrinum*) (2nd cut), parsley (*Petroselinum crispum* Mill) and rocket (*Eruca vesicaria* L.) from each sites were collected in January 2001. Soil samples were analyzed to determine $CaCO_3$, EC (soil paste) according to Jackson (1967). Particle size distribution was determined according to Piper (1950). Plant samples were digested using nitric with perchloric acids and determined according to Olson (1973). Soil available selenium was extracted using NH_4HCO_3-DTPA (AB-DTPA) according to soltanpour and workman (1979 and 1980). Selenium extracted from both soil and plant were complexed with 2,3 diaminonaphthalene and extracted with cyclohexan. The intensity of the colour is measured by spectrophotometer (Lott *et al.* 1963).

RESULTS AND DISCUSSION

Data presented in table (1) revealed that the soil of Giza governorate have low calcium carbonate, which average is 4.24±1.94%. As for EC, the average is 3.66±2.88 dS/m. The soil have relatively high clay percent.

Table (1): Some characteristics of Giza governorate soils(36 soil samples).

	$CaCO_3$ %	EC dS/m	C.sand %	F.sand %	Silt %	Clay %
Mean	4.24	3.66	9.91	18.34	24.37	42.75
Stdv.	1.94	2.88	10.46	7.36	6.05	11.49
Max.	8.59	12.84	55.71	37.09	34.74	60.52
Min.	0.64	0.90	0.59	5.32	5.96	19.60

The data of dry weight percent of berseem, parsley and rocket plants range between 7.46 and 13.76%, 4.98 and 12.17%, 5.31 and 8.36% respectively. While the average values are 10.59, 9.24 and 6.65% for those three plants, (table 2).

Table (2): Plant dry weight percent (%) of berseem, parsley and rocket .

Site name	Berseem	Parsley	Rocket
El-Mansoria	10.46	9.46	7.41
Oseem	10.46	6.94	5.69
Kombera	9.20	9.94	6.15
Berk El-Khiam	10.51	10.75	5.31
Kerdasa	8.75	4.98	6.45
Saft Ellaban	12.99	10.71	6.61
Nahia	10.51	9.64	5.59
Koniiasa	10.56	9.35	7.36
Abu El-Nomors	7.46	8.23	6.18
Met Rahina	10.56	11.43	7.03
Dahshor	12.14	7.26	8.36
El-Aiat	13.76	12.17	7.61
Mean	10.59	9.24	6.65
Std	1.67	1.98	0.89
Max	13.76	12.17	8.36
Min	7.46	4.98	5.31

In general, the available Se in the surface soils samples of Giza governorate ranged from 0.005 to 0.024 $\mu g.g^{-1}$, with averaging of 0.013 $\mu g.g^{-1}$. The linear regression of soil Se encounter EC is depicted in fig.(1) and the equation is written as;

$$\text{Soil Se} = 0.0146 - 0.000491\ EC \quad (r = 0.342^{*}\ , n=36)$$

Although the significant negative correlation is found between available soil Se and EC (of soil paste) at 5%, the very low constant b (=0.000491) shows that the regression is relatively low significantly negative trend. Also, the low threshold may be attributed to the low overall Se values in those soil samples. These values throw light on the deficient of soil Se in Giza governorate. Wu (1988) concluded that repeated harvesting of the grass much of the Se may be removed from the soil.

Soils cultivated with Egyptian berseem have also very low available Se ranging from 0.009 to 0.024 $\mu g.g^{-1}$, with averaging of 0.015 $\mu g.g^{-1}$. While those cultivated parsley range from 0.005 to 0.019 $\mu g.g^{-1}$ with average 0.011 $\mu g.g^{-1}$. As for the soils cultivated with rocket plants, available Se values range from 0.008 to 0.018 $\mu g.g^{-1}$ with average 0.013 $\mu g.g^{-1}$.

Table (3): Available selenium (μg.g^{-1})of the soil cultivated with berseem, parsley and rocket plants.

Site name	Berseem	Parsley	Rocket
El-Mansoria	0.011	0.005	0.008
Oseem	0.014	0.012	0.017
Kombera	0.017	0.007	0.009
Berk El-Khiam	0.014	0.011	0.008
Kerdasa	0.009	0.010	0.009
Saft Ellaban	0.018	0.009	0.016
Nahia	0.014	0.014	0.015
Koniiasa	0.010	0.007	0.010
Abu El-Nomors	0.012	0.015	0.017
Met Rahina	0.024	0.014	0.014
Dahshor	0.019	0.019	0.01
El-Aiat	0.012	0.009	0.012
Mean	0.015	0.011	0.013
Std	0.004	0.004	0.004
Max	0.024	0.019	0.018
Min	0.009	0.005	0.008

The values of Se concentration in berseem plant range between 0.045 to 0.146 μg.g^{-1} with average value 0.083 μg.g^{-1}, (table 4). The significant positive correlation between Se of both soil available and berseem concentration shows the behaviour of Se transporting from soil to plants. Fig.(1B) depicte the linear regression trend between available Se in the soil and that of berseem plants and the equation is ;

plant -Se = 0.0236 + 4.10 soil –Se (r = 0.632*, n=12)

Concern parsley, the values of plant Se concentration range from 0.018 to 0.076 μg.g^{-1} with average 0.038 μg.g^{-1}, (table 4). Fig.(1C) depicte the significant regression trend with equation between Se values of both soil available and those of parsley plants and the equation is:

Plant-Se = - 0.0024 + 4.31 soil-Se (r = 0.607*, n = 12)

Selenium concentration of rocket plants range from 0.018 to 0.076 μg.g^{-1} with average 0.038 μg.g^{-1}. There is a positive significant regression between soil available Se and those of rocket (fig.1D). The regression equation represented this relation is;

Plant-Se = 0.0091 + 2.28 soil-Se (r = 0.603*, n=12)

The relatively high values of constant b for berseem, parsley and rocket equations (4.10, 4.31and 2.28) explain the confirmed behaviour of transporting Se from soil to plant. While the values of threshold concern the above three equations around zero, show the absorption of Se by these plants porportionaly increases with increasing soil Se. Arbestain (1998) reported that total shoot Se corresponded to 1-9% of soluble Se removal.

Table (4): Selenium concentration ($\mu g.g^{-1}$) in berseem, parsley and rocket plant.

Site name	Berseem	Parsley	Rocket
El-Mansoria	0.095	0.019	0.043
Oseem	0.046	0.028	0.035
Kombera	0.088	0.031	0.039
Berk El-Khiam	0.078	0.082	0.018
Kerdasa	0.070	0.018	0.023
Saft Ellaban	0.085	0.065	0.046
Nahia	0.110	0.085	0.043
Koniiasa	0.051	0.018	0.030
Abu El-Nomors	0.095	0.059	0.038
Met Rahina	0.146	0.018	0.034
Dahshor	0.081	0.088	0.076
El-Aiat	0.051	0.030	0.032
Mean	0.083	0.045	0.038
Std	0.027	0.027	0.014
Max	0.146	0.088	0.076
Min	0.045	0.018	0.018

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حالة وسلوك السيلينيوم فى الأرض و النبات:
1- السيلينيوم فى محافظة الجيزة

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تم جمع 36 عينة تربة و مثلها من النباتات النامية عليه (البرسيم المصرى ، البقدونس ، الجرجير) من أثنى عشر موقع فى محافظة الجيزة خلال شهر يناير 2001. و لقد استخلص عنصر السيلينيوم الميسر فى التربة بأستخدام مستخلص AB-DTPA. و ان السيلينيوم فى مستخلصات التربة و النبات تم قياسهما باستخدام جهاز قياس الطيف.

أوضحت النتائج أن أراضى محافظة الجيزة منخفضه نسبيا فى محتواها من كربونات الكالسيوم و متوسطه الملوحه و ذات محتوى عالى نسبيا من الطين. و كانت القيم المتوسطه للنسبة المئوية للمادة الجافة فى نباتات البرسيم و البقدونس و الجرجير هى 10.76، 6.24، 6.65%. وعموماً كانت قيم السيلينيوم الميسر فى الأراضى منخفضاً جداً ويساوى 0.013 ميكروجرام/جرام فى المتوسط و أنه يرتبط ارتباطا معنوياً سالباً مع ملوحة التربة. و كانت متوسط القيم للسيلينيوم فى نباتات البرسيم، البقدونس و الجرجير 0.083، 0.045، 0.038 ميكروجرام/جرام على التوالى. وأن السيلينيوم الميسر فى التربة تربتط أرتباطاً معنوياً موجباً مع السيلينيوم الممتص بواسطة النباتات النامية عليه و كانت قيم معامل الأرتباط 0.632* ، 0.607* ، 0.603* على التوالى لكل نبات.