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MINERAL ANALYSIS OF SOIL, EUPHORBIA HIRTA L. AND MYCOFLORA FROM THE INDUSTRIAL YANBU CITY, SAUDI ARABIA

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التحليل المعدني للتربة ولنبات الخنيز والفلورا الفطرية لمدينة ينبع الصناعية بالمملكة العربية السعودية

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تم جمع عينات لكل من التربة ونبات الخنيز من خمسة مواقع في مدينة ينبع الصناعية بالمملكة العربية السعودية وحللت لمعرفة كل من محتواها المعدني والفلورا الفطرية .

وأوضحت الدراسة أن التربة رملية وقلوية وتحتوي نسبة قليلة من كل من المواد العضوية والمحتوى المائي والأملاح الكلية الذائبة .

كما بينت الدراسة أن كلا من التربة والنبات تشتمل علي تراكيز عالية من الألومنيوم يليه النحاس فالزنك فالمنجنيز فالكادميوم ثم الرصاص .

تم خلال هذا البحث التعرف على ١٢ نوعاً من الفلورا الفطرية تنتمي لثمانية أجناس فطرية وتم عزلها من الغلاف الجذري لتربة نبات الخنيز .

التراكيز العالية من عناصر الألومنيوم والنحاس والخارصين التي سجلت خلال البحث ربما تسهم في اضعاف امتصاص بعض العناصر الغذائية الكبيرة مثل الكالسيوم والبوتاسيوم .

Key Words : Mineral analysis, *Euphorbia* hirta L., Mycoflora

ABSTRACT

Soil and *Euphorbia* hirta L. samples were collected from five localities from the industrial Yanbu city Saudi Arabia, and analysed for their metal and fungal flora. Soil type is sandy, alkaline and contained low percentage of total organic matter, moisture content and total soluble salts. Soil and plant contained high concentration of Al followed by Cu, Zn, Mn, Cd and Pb. Twelve species of fungal flora belonging to eight genera of fungi were isolated from the rhizosphere soil of *E. hirta L. Viz, A. alternata, A. chlamydospora, A. candidus, A. clavatus, A. niger, C. herbarum, C. lunata, F. solani, P. chrysogenum, R. stolonifer* and *U. atrum.*

INTRODUCTION

Industrial Yanbu city is the one of the corner stones of Saudi Arabia's industrial development and diversification program. In late 1977, the Royal commission completed a 30-year master plan for the development of the industrial Yanbu city complex on the Red Sea about 300 kilometers north of Jeddah.

Environmental pollution, especially by chemicals, is one of the most effective factors in the destruction of the biosphere components, among all chemical contaminations, trace elements are believed to be of a specific ecological, biological, and health significance [1].

Soil is a very specific component of the biosphere because it is not only a geochemical sink for contaminations, but also acts as a natural buffer controlling the transport of chemical elements and substances to the atmosphere biota. Heavy elements originating from various sources may finally reach the surface soil, and their further fate depends on soil chemical and physical properties. Plants can accumulate heavy metals in or on their tissues due to their great ability to adapt to variable chemical properties of the environment, thus palnts are intermediate reservoirs through which heavy metals from soils, and partly from waters and air, move to man and animals. [2].

Although a great deal is known about the fungal flora of Saudi Arabia [3-8], none of these investigations has focused upon the fungal flora of the rhizophere soil of *Euphorbia hirta L.* from the industrial Yanbu city, Saudi Arabia. The present study was undertaken to determine the mineral analysis of soil, *Euphorbia hitra L.* and mycoflora from the industrial Yanbu city.

Euphorbia hirta L. a common weed of farms and gardens, belongs to the family Euphorbiaceae. It is a prostrate, annual herb with few upright branches reaching up to 40 cm high. The whole plant is used as a sedative and to assist the breathing of asthmatics. It has been reported from several regions in Saudi Arabia [9, 10].

MATERIAL AND METHODS

Soil samples were collected from different localities of the industrial Yanbu city according to the method described by Johnson et al. [11] at a depth of 1-30 cm during the month of September (1993) in which the temperature was 34^{o}C and the percentage humidity was 60%. Five collections of a total weight of 1000 gm from each locality were mixed and used for soil analysis and isolation of fungal flora.

The soil type was determined by the hydrometer method as described by Piper [12]. Determination of moisture content, organic matter, total soluble salts and pH value of each soil sample were determined according to the techniques devised by Black *et al.* [13]. For metal analysis, soil samples were passed through a 2.0 mm sieve and were digested in concentrated nitric acid to obtain a measure of total metal content [7] to determine Al, Cd, Cu, Mn, Pb and Zn. *Euphorbia hirta L.* was collected from different places of the industrial Yanbu city from the same soil. A detailed analysis of the mineral contents of plants were mentioned earlier [8]. The dilution plate method was used for the determination of fungal flora as described by Hashem [14]. The fungal genera and species were identified according to [15-19].

RESULTS AND DISCUSSION

Soil types were sandy in all different localities. The total organic matter for the tested soil ranged between 0.98% and 1.22%, while moisture contents between 2.95% and 4.61%. Total soluble salts ranged between 0.81% and 1.03%, the pH values of the soil samples reveal no appreciable differences and all were alkaline with pH ranging from 7.0 to 7.4 (Table 1). The effect of organic matter, moisture content and total soluble salts of soil samples were negligible since all soil samples contained low percentages and this is consistent with the findings of earlier studies on some Saudi Arabian soils [4, 8, 14, 20, 21].

The results of total metals content of the tested soil are summarized in Table (2). Soil samples differed greatly. The concentrations of Al in the tested soil in the present study, were similar to earlier findings in some Saudi Arabian soils [7, 22], and in some soils from different places in the world [23, 24].

Cadmium content of surface soils of different countries ranged from 0.2 to 400 µg/g [25, 26]. In the present study, cadmium content of different localities ranged from 2 to 6 pg/g. The content of Cu in the present study, resembles that of earlier findings [7, 22, 27, 28].

The common range of Mn in soil is 350 to 2000 µg/g [1]. This element is essential in plant nutrition and controls the behavior of several other micronutrients. Lead content in the top horizon of different soils from various countries ranges from 3 to 189 µg/g [29-31]. In the present study, Pb content of analysed soils ranged from 3 to 6 µg/g. The mean Zn content in surface soils of different countries ranges from 17 to 125 µg/g as total content [32, 33].

Heavy metal analysis of *Euphorbia hitra L.* indicated a high aluminium concentration compared to Cd, Cu, Mn, Pb and Zn Table (3). The concentration of Al in the plants studied ranged from 80-93 µg/g dry weight which is close to the average of 200 µg/g concentration generally found in the plants [1]. However, Al concentration was reported to be as high as 5000 µg/g in some tea plants [34]. Although Cd is considered to be a non-essential element for plants, it is effectively absorbed by both the root and leaf systems. Mean cadmium content of plants from different places in the world ranged from 0.02-6 pg/g [35-37]. Cd content, in the plant in the present study, ranged from 0.1 to 0.6 µg/g. Copper in low quantity is required for the good development and growth of plants [38]. However, the concentration of Cu varied in different parts of plants [39]. The Cu concentration in the tested plant was within the range from 5-11 µg/g.

The concentration of Mn in the plant studied here ranged from 5-9 µg/g, although a wide range of this element of 30-500 µg/g in other plants was reported earlier [2].

Although Pb occurs naturally in all plants, it has not been shown to play any essential roles in their metabolism[40]. The great variation of Pb contents in plant is influenced by several environmental factors, ranging from 0.1 to 10 µg/g [41]. In the present study, Pb ranged from 1-3 µg/g. Zinc has an essential role in the metabolism of higher plants [42, 43] and is found in the range of 6-47 µg/g [44-45]. Our results yielded a range of 8-13 µg/g Zn in the plant tested which is somewhat lower than the normal concentrations reported from other plants [35]. Although the concentration of Zn has been reported to be as high as 300 μg/g in some plants [46] but concentration range of 300-400 μg/g is toxic to most plants [46-47].

A total number of 12 species belonging to 8 genera of fungi were isolated from the soil of the tested localities (Table 4). Fungal species isolated in the present study, were reported earlier from Saudi Arabian soils [3.4.5.6.8.14.20.21]. *A. Alternata, A. niger, P. notatum, Curunlaria luanata and R. stolonifer* were the dominating species in the tested localities followed by *A. chrysogenum, A. candidus, C. herbarum, F. solani, and U. atrum.*

Pollution of soil and plant by heavy metal occurs due to industrial wastes, application of fertilizers, corrosion of sheeting, wires, pipes and burning of coal and wood.

Biological and microbiological factors also contribute heavy metal pollution. The importance of microorganisms as reflected in biological activity of soils has been discussed very well. The abundance of microorganisms in soils varies with soil and climatic conditions.

Microorganisms are very important ecologically beacuse they are the producing, consuming and transporting members of the soil ecosystem and therefore involved in the flow of energy and in the cycling of chemical elements [48]. Overall, the effect of heavy metals on soil fungi may be generally toxic at high concentrations [14, 49, 50], but some fungi appeared to benefit from some treatments [51, 52]. In the present study, the degree of metal toxicity on the distribution of fungal flora varies from one metal to another.

Heavy metals released by human activities such as industrial wastes, application of fertilizers and burning of coal may be enriched and become available at potentially toxic concentrations for microorganisms. The tolerance of some fungi to heavy metals are well documented [53-54]. They have been reported to grow in soil contaminated with higher levels of metals than those tolerated by higher plants [55]. It appears that levels of heavy metals in the present study affected the fungal distribution. Higher concentrations of heavy metal may cause damage fo the cell wall, denaturation or coagulation of protein and inhibition of enzymes action [56].

Interactions of chemical elements are also one of similar importance to deficiency and toxicity in the physiology of plants and fungi [1, 57]. In the present study, high concentration of Al, Cu, and Zn may inhibit absorption of macroelement such as Ca, K and Mg and this could affect the density of fungal flora in some tested localities [58, 59].

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Table 1
Soil type, percentage of organic matter, moisture content, total soluble salts and pH values of the tested localities (n = 5).

Locality	Soil Type	Organic Matter %	Moisture Content %	Total Soluble Salt %	pH Value
Al-Firouse	Sandy	1.03	3.21	0.96	7.3
Al-Morjan	Sandy	0.93	4.19	1.03	7.2
Al-Semairi	Sandy	1.11	2.95	0.83	7.0
Al-Yagout	Sandy	1.22	4.16	1.00	7.4
Al-Radwa	Sandy	0.98	4.01	0.81	7.3

Table 2
Total metals content (µg/g) of the soil samples from different localities (n = 5, + standard deviation).

Locality	Total Metal Content (µg/g)					
	Al	Cd	Cu	Mn	Pb	Zn
Al-Firouz	130 ± 2.1	3 ± 0.81	33 ± 0.32	15 ± 0.81	3 ± 0.21	28 ± 0.81
Al-Morjan	119 ± 2.0	2 ± 0.3	30 ± 0.81	13 ± 0.63	4 ± 0.31	32 ± 0.78
Al-Semairi	100 ± 1.1	3 ± 0.72	31 ± 0.62	21 ± 0.51	5 ± 0.45	36 ± 0.37
Al-Yagout	106 ± 2.3	5 ± 0.31	28 ± 0.81	10 ± 0.51	8 ± 0.23	31 ± 0.69
Al-Radwa	113 ± 2.3	6 ± 0.45	25 ± 0.62	16 ± 0.66	6 ± 0.16	35 ± 0.81

Table 3
Total metals content (µg/g) of the Euphorbia hirta L collected from different localities (n =5, ± standard deviation).

Locality	Total Metal Content (µg/g)					
	Al	Cd	Cu	Mn	Pb	Zn
Al-Firouz	90 ± 1.8	0.3 ± 0.05	11 ± 1.11	7 ± 0.13	3 ± 0.91	8 ± 0.87
Al-Morjan	80 ± 1.3	0.1 ± 0.01	9 ± 1.01	9 ± 0.31	3 ± 0.16	10 ± 0.93
Al-Semairi	87 ± 1.5	0.2 ± 0.03	6 ± 0.61	6 ± 0.61	2 ± 0.11	13 ± 0.69
Al-Yagout	91 ± 1.11	0.6 ± 0.07	8 ± 0.85	8 ± 0.92	1 ± 0.19	9 ± 0.92
Al-Radwa	93 ± 1.61	0.5 ± 0.04	10 ± 0.69	5 ± 0.19	2 ± 0.25	11 ± 0.53

Table 4

Mycoflora isolated from soils of different localities.

Species	Number of colonies per gram oven dry soil					
	Al - Firouze	Al- Morjan	Al- Semiari	Al- Yagout	Radwa	Freq %
Alternata alternata	3	6	8	7	4	100
Alternaria chlaymdospora	1	-	-	3	-	40
Aspergillus candidus	3	6	2	-	-	60
Aspergillus clavatus	-	-	2	3	-	40
Aspergillus niger	9	8	6	11	7	100
Cladosporium herbarum	6	-	7	-	-	40
Curvulvria lunata	3	8	6	5	3	100
Fusarium solani	-	2	3	-	1	60
Penicillium chrysogenum	4	2	6	-	3	80
Rhizopus stolonifer	3	2	6	3	7	100
Ulocladium atrum	5	-	-	3	4	60

$$\% \text{ Frequency} = \frac{\text{No. of sites in which the species was found}}{\text{Total No. of sites}} \times 100$$

- = not found

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