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Mycoflora of Aluminium Rich Soil of Hail Region, Saudi Arabia

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ABSTRACT. Soil samples collected from Al-Zubira village of Hail region, Saudi Arabia, were screened for mycoflora and analyzed for mineral contents. The fungal genera isolated were *Aspergillus* (6 species), *Alternaria* and Fusarium (3 species each), *Penicillium* and *Ulocladium* (2 species each).

Artemisia monosperma, Calligonum polygonoides, Farsetia aegyptia and *Zilla spinosa* growing frequently in the same locality, were also collected and analyzed for heavy metals contents in the roots and shoots. Aluminium was found in high amount in all these plants and also in soil samples collected from Al-Zubira village followed by copper, lead and zinc.

Al-Zubira village is a remote area, located about 200 km. North-East of Hail, Saudi Arabia. Recently an encouraging quantity of bauxite ore estimated about 200 million metric tons was discovered in Al-Zubira village. Out of these 126 million tons contain from 50% to 75% of aluminium oxide and 6% silicon oxide (Hail Governor Office).

The mycoflora of Saudi Arabian soil has been studied earlier with more focus on the central and South-Western parts (Abdel-Azim and Kassim 1972. Abu-Zinada *et al.* 1977, Kashkari 1987, Abdel-Hafez 1982, 1985, Hashem, 1991, 1993b). Recently, Bokhary and Parvez (1992a, b), Hashem (1993d) reported on the soil mycoflora from Northern parts of Saudi Arabia. No information is a available about the fungal flora of the soil from Hail region. The heavy metal contents in wild plant are also hardly studied in Saudi Arabia (Hashem and Al-Farhan 1993a). Therefore the aim of this work was to study the fungal flora of bauxite rich soil and also the heavy metal contents in the plants growing in these areas.

Materials and Methods

Soil and plant samples were collected in sterile polyethylene bags from five different sites (Fig. 1) at Al-Zubira village (five samples from each site). Soil type was

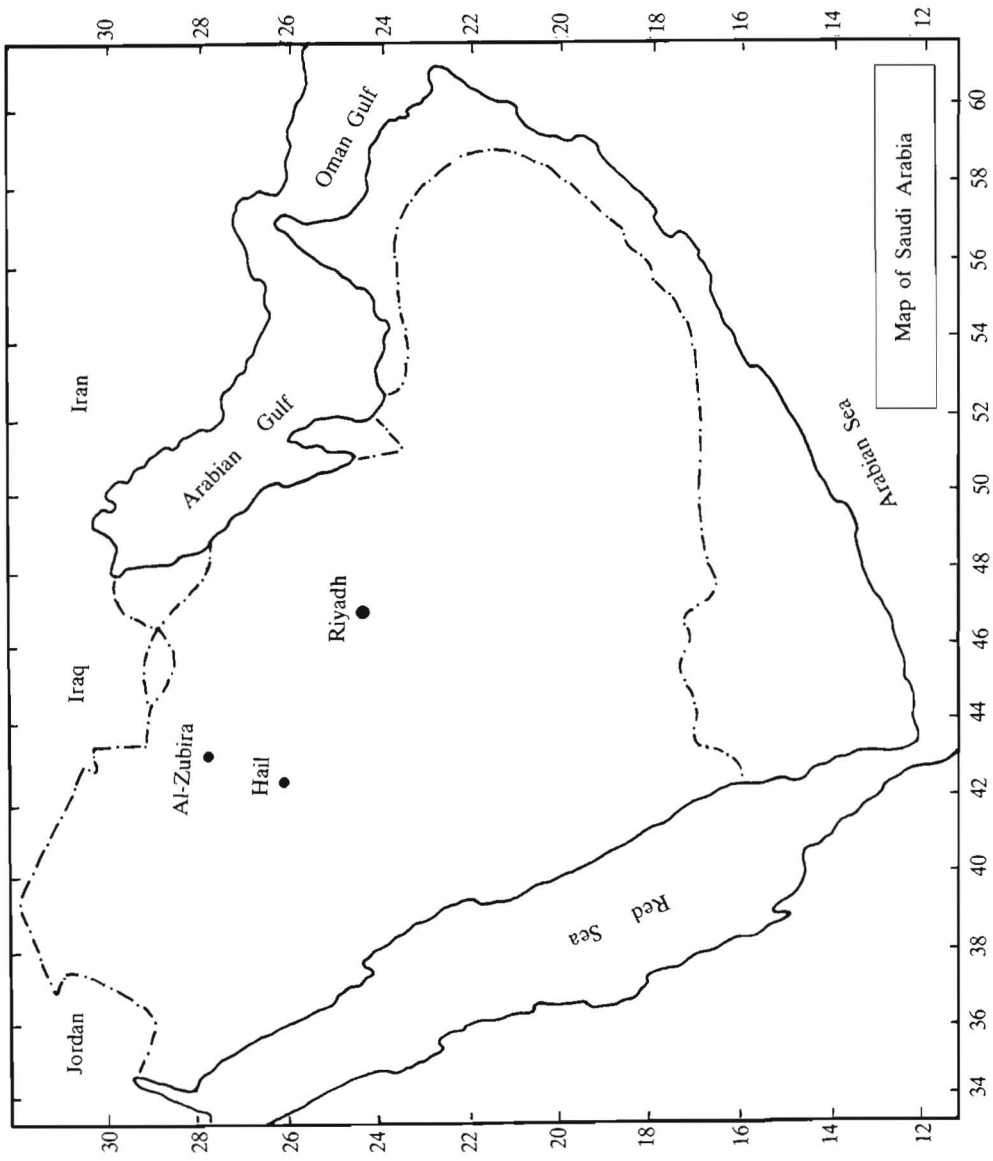

Fig.1. Map showing the site of soil and plant samples collection.

determined by hydrometer method Piper (1955). Soil organic matter contents and pH value were determined according to method adopted by Jackson (1958). For heavy metals analysis, soil samples at first were passed through a 2 mm sieve. Then 0.5 g of air dried soil (five replicate) was placed in a 100 ml beaker and digested with 15 ml of conc. HNO_3 at 95-100°C for 15 min. After digestion, the digest was made up to 50 ml by adding deionised water. Aluminium, copper, lead and zinc contents of soil were then analyzed by using spectrophotometer (Pye Unicam SP9 equipped with SP9 computer) as adopted earlier (Hashem 1990).

Soil fungi were isolated by the dilution plate method as adopted earlier by Bokhary *et al.* 1984). Czapek-dox agar (BDH-Chemicals, London) was used for preliminary isolation of fungi. Rose bengal 0.03 g/1 was also added in the medium to reduce the spread of fast growing funig, while streptomycin sulphate (0.033 g/1) was added to eliminate bacterial growth. Inoculated plates were incubated at 30°C for 7 days. Identification of isolated fungi is carried out with the help of following literature: Ellis (1971, 1976), Gilman (1971), Nelson *et al.*(1983), Pitt (1979), Ramirez (1982), Raper and Fennell (1965).

For the analysis of heavy metals contents of plants, roots and shoots were washed in tap water several times (to get rid of all adhered soil). This is followed by washing in distilled water. Plant samples (roots and shoots) were cut into small pieces and then analyzed for heavy metals contents as described earlier for soil analysis.

Results and Discussion

The soil of Al-Zubira village is sandy, slightly alkaline and low in organic matter (Table 1). These results are in agreement with the earlier reports on Saudi Arabian soils (Ali and Abou-Heilah 1984, Abdel-Hafez 1982, 1985, Hashem 1991), Aluminium was found in far greater amount than other heavy metals as expected (Table 2). The content of aluminium in the soils from Al-Zubira was 4-6 times higher than reported from other soils of Saudi Arabia (Hashem 1990).

Aluminium contents in the shoots and the roots of the four plants were also higher than zinc, copper and lead (Table 3). The quantity of a metal in the four types of studied plants do not vary and almost similar readings are observed for a particular type of plant collected from the five sites.

Aluminium ions in the soil at a lower concentration had a stimulating effect at pH 3.6 to pH 5 but at higher concentrations this become toxic by inhibiting the uptake of essential elements like phosphorus, calcium and potassium (Bollard and Butler 1966). High concentrations of aluminium in the alkaline soils normally do not affect the

growth of plants with a few exceptions (Bollard and Butler 1966, McCart and Kampath 1965). Probably this is the reason that plants could grow and tolerate the higher concentration of aluminium in the soils of Al-Zubira village.

Sixteen fungal species belonging to five genera of fungi have been isolated from Al-Zubira soil (Table 4). The genus *Aspergillus* was predominant with six species followed by *Alternaria* and *Fusarium* with three species each, *Penicillium* and Ulocladium represented by two species each. *Alternaria, Aspergillus, Fusarium, Penicillium* and *Ulocladium* are common soil mycoflora which were isolated earlier from different types of soils in Saudi Arabia (Bokhary *et al.*1984, Hashem 1991, Bokhary and Parvez 1992a, b). The presence of these fungi in aluminium rich soil indicate that they could tolerate high concentration of aluminium due to the alkaline nature of soil.

Soil pollution with heavy metals occurs due to different human activities such as industrial wastes, heavy application of fertilizers and burning of coal and wood. other biological and microbiological factors also might contribute to heavy metal pollution.

The effect of organic matter content of soil samples looks negligable since all soil samples contained low percentage. The present study reveals that heavy metal contents in the tested soil were high and could affect the density and diversity of fungal flora of the soil (Hashem 1993 c).

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Table 1. Soil characteristics of different samples from Al-Zubira village (Values are means of 5 replicates)

Sample No.	Soil Type	% Organic Matter	pH Value
1	Sandy	0.61	7.21
2	Sandy	0.73	7.31
3	Sandy	0.91	7.01
4	Sandy	0.89	7.61
5	Sandy	0.49	7.13

Table 2. Total metals content (µg/g) of soils from Al-Zubira village (n=5,± standard deviation)

Sample No.	Heavy metal content (ug/g)			
	Al	Cu	Pb	Zn
1	480 ± 6.3	21 ± 1.8	8 ± 2.1	23 ± 1.7
2	630 ± 9.1	18 ± 1.1	3 ± 2.0	20 ± 1.6
3	663 ± 5.4	15 ± 0.9	5 ± 1.9	16 ± 2.5
4	589 ± 7.6	20 ± 2.6	7 ± 1.6	18 ± 2.3
5	521 ± 9.1	24 ± 2.1	9 ± 1.3	21 ± 2.1

Table 3. Total heavy metals content (µg/g) in the shoots and roots of plants collected from Al-Zubira village (n=5, ± standard deviation)

Plants	Heavy metal content (µ/g)			
	Al	Cu	Pb	Zn
Artemisia monosperma	73±3.91	6 ± 0.92	1.0 ± 0.06	8 ± 0.91
Calligonum polygonoides	80 ± 3.0	5 ± 0.83	090 ± 0.01	6 ± 0.36
Farsetia aegyptia	71±2.01	7 ± 0.69	1.1 ± 0.05	7 ± 0.90
Zilla spinosa	83 ± 2.61	4 ± 0.60	0.86 ± 0.03	9 ± 0.73

Table 4. Mycoflora isolated from Al-Zubira soil

Species	No. of colonies per gram of soil
Alternaria alternata (Fr.) Keissler	42 ± 13
Alternaria chlamydospora Mouchacca	25 ± 5
Alternaria phragmospora van Emden	17 ± 11
Aspergillus clavatus Desmazieres	25 ± 11
Aspergillus flavus Link ex Fries	28 ± 9
Aspergillus niger van Teighem	47 ± 7
Aspergillus candidus Link ex Fries	29 ± 5
Aspergillus nidulans (Eidam) Winter	20 ± 4
Aspergillus terreus Thom	20 ± 6
Fusarium moniliforme Scheldon	5 ± 2
Fusarium oxysporum Scheldon	16 ± 5
Fusarium solani (Mart.) Sacc.	48 ± 11
Penicillium chrysogenum Thom	19 ± 6
Penicillium citrinum Thom	5 ± 2
Ulocladium chlamydosporum Monchacca	33 ± 4
Ulocladium consortiale (Thom.) Simmons	10 ± 3

Readings are the mean of 5 replicates
± Standard deviation

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الفلورا الفطرية للتربه الغنية بعنصر الألومنيوم في منطقة حائل ـ المملكة العربية السعودية

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ص.ب: ٢٤٥٥ ـ الرياض ـ ١١٤٥١ ـ المملكة العربية السعودية

تم جمع عينات مختلفة من التربة والنباتات من قرية الزبيرة الواقعة في منطقة حائل ـ المملكة العربية السعودية وقد جرى تحليلها لمعرفة محتواها المعدني والفطري.

أوضحت نتائج الدراسة أن الاجناس الفطرية التي تم عزلها كانت كالتالي:

Aspergillus (٦ أنواع) و *Alternaria* and *Fusarium* (٣ أنواع) *Penicilium* and *Ulocladium* فقد تم عزل نوعان منه. كما كانت نتائج تحليل التربة أنها رملية وقاعدية وفقيرة في محتواها العضوي.

أما العينات النباتية التي تم جمعها فكانت:

Artemisia monosperma, Caligonum polygonoides, Farsetica aegyptia and *Zilla spinosa* و التي تحتوي على نسبة عالية من عنصر الالومنيوم يليه عنصر الخارصين والنحاس ثم الرصاص. كما كانت نتائج تحليل التربة أيضاً تحتوي على نسبة عالية من عنصر الالومنيوم يليه عنصر الخارصين والنحاس والرصاص.

وقد تمت مناقشة النتائج المتحصل عليها في هذه الدراسة مقارنة بـالابحاث التي أجريت في أماكن مختلفة من العالم.