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TOXICITY OF COBALT AND NICKEL TO *FUSARIUM SOLANI* ISOLATED FROM SAUDI ARABIAN SOIL

By

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أثر عنصر الكوبالت والنيكل على نمو فطرة فيوزاريوم سولاني

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تمت في هذه الدراسة ملاحظة أثر عنصر الكوبالت والنيكل على نمو فطرة فيوزاريوم سولاني والتي عزلت من تربة المملكة العربية السعودية .

وقد استخدمت البيئات السائلة والتي تحتوي على التراكيز المختلفة من عنصر الكوبالت والنيكل من تركيز صفر وحتى ٣٠٠ جزء في المليون . وقد أوضحت نتائج الدراسة أن الفطرة فيوزاريوم سولاني ذات مقاومة لعنصر الكوبالت أكثر من عنصر النيكل . أيضاً تمت في هذه الدراسة تقدير نسبة تركيز كل من عنصري الكوبالت والنيكل والتي تم إمتصاصها بواسطة الفطرة فيوزاريوم سولاني . تعتبر هذه الدراسة مهمة جداً لكشف المزيد عن التلوث بالمعادن الثقيلة وخاصة عنصري الكوبالت والنيكل في المملكة العربية السعودية .

Key Words: Toxicity, Cobalt, Nickel, *Fusarium solani.*

ABSTRACT

Fusarium solani isolated from Saudi Arabian soil was able to grow on liquid media containing up to 300 ug/ml cobalt or nickel. *F. solani* was tolerant to cobalt than nickel. The results provide evidence of the accumulation of cobalt and nickel in the mycelium of *F. solani*, which might be important in dealing with cobalt and nickel pollution in Saudi Arabia.

INTRODUCTION

Trace elements originating from various sources may finally reach the surface soil, and their further fate depends on chemical and physical properties of the soil. Although the chemistry of soil contaminations recently has been the subject of many studies, our knowledge of the behavior of polluting trace elements is far from complete [1]. The phenomenon of fungal adaptation to metal toxicants is well known [2-7]

Some fungi have been reported to grow in soil contaminated with heavy metals and it is evident that fungi can withstand levels of metals higher in excess of those tolerated by higher plants [8]. As there is no information available on the responses of *Fusarium solani* isolated from Saudi Arabian soils to heavy metals, this study was designed to determine the toxicity of cobalt and nickel to *F. solani* when applied in different concentrations in liquid media.

MATERIALS AND METHODS

Fusarium solani (Martius) Saccardo was isolated from Ashafa soil (Saudi Arabia) [9] and identified according to Gilman [10], Barnett and Hunter [11], and Booth [12]. Discs of mycelium were cut from the margin of actively growing colonies using a 7 mm diameter sterile cork borer and transferred to 100-ml conical flasks (1 disc/flask) containing 50 ml malt extract medium (malt extract 1.0 g, distilled water 1000 ml) to which CoSO4 or NiSO4. $6H_2O$ was added to give final concentrations of 0, 100, 200 and 300 ug/ml. The media were adjusted to pH 4.0 before being sterilized by filtration (0.45 um). Flasks were incubated at 25°C. Harvests were taken at 14, 28 and 42 days. At harvests, mycelia were

transferred to preweighed filter papers, thoroughly washed with dionized water, oven-dried at 80°C for 24 hours and weighed.

Cobalt or nickel concentrations in the mycelia were determined by atomic absorption spectrophotometry after nitric acid digestion [5, 13, 14].

The relative tolerance of *F. solani* to Co or Ni was calculated as a tolerance index [5, 7, 14]. The pH of the residual medium was measured.

RESULTS

The relative tolerance of the isolate of *F. solani* was calculated as a tolerance index (Fig. 1), The results indicate that *F. solani* has a higher tolerance of Co than that of Ni.

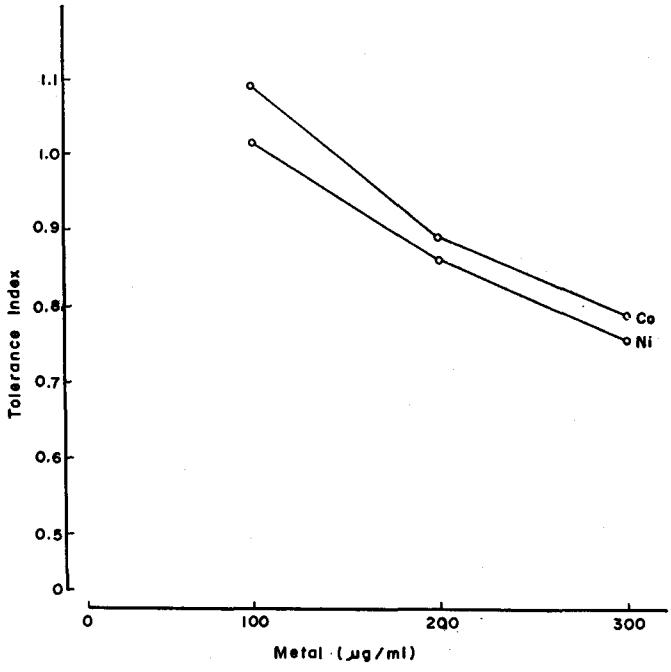

Fig. 1: Tolerance index from mycelium dry weight (mg) and cobalt or nickel concentration (ug/ml) after 42 days growth of *F. solani.* Values given are means of 5 replicates.

The results of cobalt and nickel concentration analysis in the mycelium of the tested fungus given in Fig. (2), clearly show that the fungus mycelium contained Co. and Ni at concentration of 2850 and 2525 ug/g respectively at the highest metal treatment.

pH declined steadily in all treatments (Co or Ni), and the fall in pH was broadly in proportion to the original Co or Ni levels, the highest metal concentration giving the lowest pH (Table 1).

DISCUSSION

While the tested fungus showed different levels of susceptibility to cobalt a or nickel at high concentrations, it showed a stimulation of yield at the low concentrations of Co. or Ni supply, this is probably because Co and Ni are essential elements for organisms. in the present study, at low external cobalt or nickel concentrations, Co or Ni presumably is transported into the cell since growth at high Co or Ni concentrations is severely inhibited.

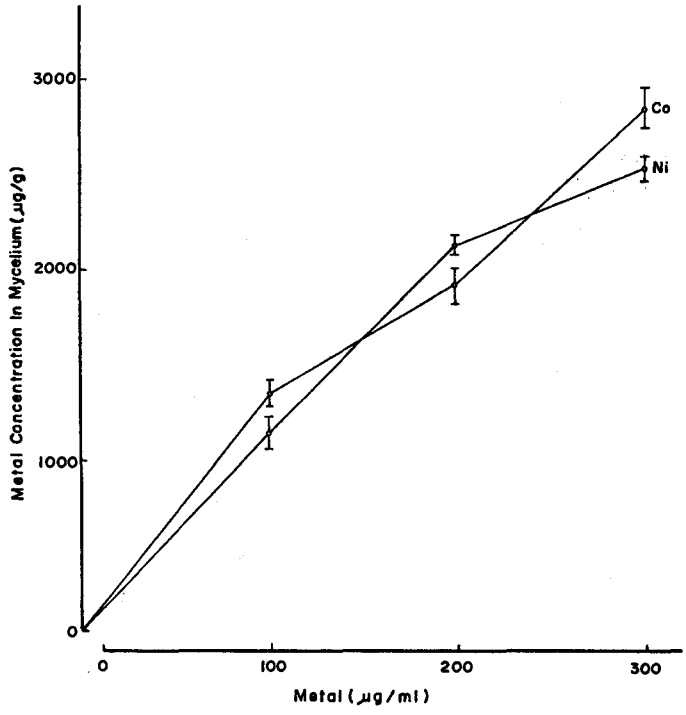

Fig. 2: Cobalt or nickel concentrations in the mycelium of *F. solani* (ug/g) after 42 days of growth in the medium treated with Co or Ni. values given are means of 5 replicates. Vertical bars represent 95% confidence limits.

Table 1

The change in the pH of filtered medium with the growth of *F. solani* (42 days). Values given are means of 5 replicates (Initial pH = 4.0).

Metals	Concentration (ug/ml)			
	0	100	200	300
Cobalt	3.91	3.7	3.65	3.51
Nickel	3.98	3.85	3.51	3.31

Although a great deal is known about the fungal flora of Saudi Arabian soils, very few report have been concerned with heavy metal contents of Saudi Arabian soils [7, 15].

In the present study, *F. solani* appeared to be more resistant to cobalt than nickel. El-Sharouny *et al.* [16] found that *F. solani* isolated from Egyptian soil was resistant to nickel in the media containing upto 5000 ppm, while Somashekar and Sreenath [6] reported that *F. solani* can grow in the media containing up to 1000 mg/L Co or Ni.

In the present investigation, the growth of *F. solani* was stimulated at a low concentration (100 ug/ml) and inhibited at a high concentration (300 ug/ml). Similarly different behavior towards Co and Ni has been observed in other fungi [2, 17, 18].

According to Ashida [2], fungi occur in various habits try to survive either by "adaptation" or by "mutation". From the present investigation, slow growth of mecelia in the beginning in media treated with heavy metals and vigorous growth after the first harvest of incubation indicate their adaptation to the new habitat to which they are exposed. A similar observation has been made by Ashida [2] and Hashem [5, 7, 13, 14].

Some studies have shown that fungi accumulate heavy metals from dilute background concentrations [7, 9, 13, 19, 20]. It is a property which could be utilized to monitor heavy metals pollution [7].

Although the effect of heavy metals on the growth of soil fungi was generally toxic, but some fungi appeared to benefit from some treatments [2, 3, 5].

Direct comparison with other studies is difficult because of the variety of media, pH affects metal toxicity and influence its form and chemical mobility, low pH increases the solubility of metal in soil [1]. In the present study, increasing Co or Ni concentrations was associated with decreasingly unfavorable pHs for the fungus growth. In summary, the data obtained in the present investigation advance our knowledge of Co or Ni resistance in *F. solani* isolated from Saudi Arabian soil.

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