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ORIGINAL ARTICLE

Usage of sewage effluent in irrigation of some woody tree seedlings. Part 3: *Swietenia mahagoni* (L.) Jacq.

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Abstract A pot experiment was investigated to study the effect of sewage irrigation treatments (primary and secondary effluents) compared with tap water on the growth and chemical constituents of mahogany seedlings (*Swietenia mahagoni* (L.) Jacq.) as well as soil chemical properties. The experiment was conducted at a greenhouse in the nursery of Timber Trees Research Department of Sabahia, Horticultural Research Station in Alexandria, Egypt, from June 2003 to December 2004 for three irrigation periods (6, 12 and 18 months). The sewage effluent waters were taken from oxidation ponds located in New Borg EL-Arab city and used directly for irrigation.

The primary effluent treatment was superior than other treatments in improving the growth parameters (plant height, stem diameter, leaf area, leaves number, fresh and dry weights of leaves, shoots and roots and shoot/root ratio) and showed the highest concentration and total uptake of N, P, K, Cd, Ni, Pb and Fe in plant parts, followed by secondary effluent then tap water. The data revealed that soil salinity in terms of electrical conductivity of saturated paste (EC), $CaCO_3$%,

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organic matter% and soluble anions and cations were influenced significantly by primary or secondary effluent treatment. The data also showed that the use of sewage effluent for irrigation increased N, P, K and DTPA-extractable-heavy metals (Cd, Cu, Ni, Pb, Fe, Mn and Zn). The effects of sewage effluent on growth parameters and elements content in plant parts and treated soil were more pronounced as water treatments were used for long period.

The results suggested that the use of sewage effluent in irrigating mahogany trees grown on calcareous sandy loam soil was an important agriculture practice for improving soil properties, increasing fuel and timber production, and is an economic and safe way to dispose wastewaters.

1. Introduction

In arid and semi-arid countries, water is becoming scarce resource to consider any sources of water, which might be used economically and effectively to promote further development. Rapid increases in population and industrial growth have led to use low quality water such as drainage and saline water as well as wastewater for irrigation.

Irrigation of forest species with wastewater for fuel and timber production is an approach which helps to overcome health hazards associated with sewage farming. Establishment of the green belts around the cities by forest trees under wastewater irrigation also helps revive the ecological balance and improves environmental conditions by self-treatment of wastewater through the application of forest irrigation.

The use of primary and secondary effluent in irrigation can improve the quality of the soil and plant growth because they are considered as natural conditioners through their nutrient elements and organic matter. However, the direct application of wastewater on agricultural land is limited by the extent of contamination with heavy metals, toxic organic chemicals and pathogens (EL-Nennah et al., 1982; Abulroos et al., 1996; Salem et al., 2000; Sebastiani et al., 2004; EL-Sayed, 2005; Singh and Bhati, 2005; Ali et al., 2010).

Swietenia mahagoni (L.) Jacq. (mahogany) is a hardwood tree belongs to family Meliaceae. Mahogany is a large tropical tree, with a height of more than 40–60 ft, a diameter at breast height (dbh) ranged from 30 to 105 cm and wood density is 560–720 kg/m^3.

Mahogany is one of the true Mahoganies that has a heavy trunk, and is considered as one of the most valuable timber trees. Mahogany is extremely strong, hard, stable and decay resistant. The color of mahogany ranges from pale pink to dark reddish brown. It is rated among the top 12 timber woods in the world. It is readily available in large widths, thick thicknesses and lengths of timber. Its rich warm color and mellow texture finishes, stains and polishes to a beautiful natural luster. This wood is used for making fine jewelleries, decorative veneers and interiors and pattern-making mahogany is used in shipbuilding and for fine boat interiors.

At times, new model automobiles are originally carved, full size, entirely out of mahogany. Once the various parts – front bumper, dashboard, the drive shaft, back to the lock on the trunk are first fashioned with this beautiful stable wood. Once the thousands of parts have been refined to fit perfectly together, they are then used as patterns to make the moulds (Mathew, 1994).

Available data about the use of sewage for irrigating forest trees in Egypt soils are limited, therefore, this work is aimed to study the effects of irrigation with sewage effluent on the vegetative growth and chemical composition of *S. mahagoni* (L.) Jacq. (mahogany), as well as the soil chemical properties.

2. Materials and methods

This study was carried out at a greenhouse at the nursery of Timber Trees Research Department of Sabahia, Horticultural Research Station in Alexandria, Egypt. The study lasted for 18 months from June 2003 to December 2004, to investigate the effects of irrigation with different treatments of sewage effluent on the vegetative growth and chemical composition

Table 1 Average composition of water used in irrigation treatments in the experiment.

Parameter	Sewage effluent		Tap water	Limits of wastewater for agric. reuse FAO (1992)
	Primary treatment	Secondary treatment		
pH	6.82	7.56	6.80	6.50–8.40
E.C. ds/m	1.60	2.96	0.68	3.00–7.00
Soluble cations (meq/l)				
Ca^{2+}	2.83	3.34	1.10	–
Mg^{2+}	2.21	3.31	1.90	–
K^+	0.23	0.26	0.20	–
Na^+	11.95	16.75	2.60	–
Soluble anions (meq/l)				
CO_3^-	–	–	–	–
HCO_3^-	4.63	5.00	2.00	1.50–8.50
Cl^-	8.41	9.34	3.80	–
DO (mg/l)	0.00	2.90	–	–
BOD_5 (mg/l)	220	100	–	40–500
COD (mg/l)	402	311	–	80–600
TSS (mg/l)	1024	1894	–	–
Soluble N (ppm)	1.25	1.08	0.26	–
Soluble P (ppm)	0.38	0.33	0.01	–
Total heavy metals (ppm)				
Cd	0.02	0.01	0.007	0.01
Cu	0.14	0.19	0.009	0.20
Mn	0.06	0.05	0.014	0.20
Ni	0.02	0.01	0.002	0.20
Pb	0.25	0.24	0.02	5.00
Zn	1.86	1.07	0.09	2.00
Fe	12.5	8.60	0.26	5.00

Dissolved oxygen (DO), biochemical oxygen demand (BOD_5) and chemical oxygen demand (COD).