INTRODUCTION

1. Introduction

Water is the primary limiting factor in any plant production, agricultural development and land reclamation and extension. Several reports indicated that Egypt is one of ten countries will be scarce of water by the year 2025, due to the rapidly increase in population (Engelman and Le Roy,1993). About 97% of Egypt's water resources are from the River Nile (Abdel – Shafy and Aly, 2002).

In Egypt, several studies revealed that untreated industrial wastes of many factories are discharged directly into the River Nile or in drains, most of them released explicitly known toxic and hazardous chemicals such as detergents, heavy metals and pesticides (Ibrahim *et al.*, 2005 and Ibrahim *et al.*, 2011).

El-Fayoum Governorate, which is located at the Northern part of the Egyptian Western desert, represents one of the promising areas for sustainable agriculture development in Egypt. The main water source of irrigation water for Fayoum region is a branch canal from the River Nile which supply the region with 3.1×10^9 m^3 water / year.

The cultivated area at Fayoum was about 160.000 ha in 1993, then increased recently to be 185000 ha. This increment in cultivated area did not accompanied with any increase in water supply, which caused water shortage in many places and problems

in land cultivation. The use of drainage water is an important strategy for supplementing water resources in areas where water is scarce.

The drainage system in Fayoum is a closed system, as a results of its distance from the River Nile and land slope towards the Qarun lake. The drainage water which estimated by about 714 million m^3/year pass through the main drains to ends up at the lake of Qarun and Wadi El-Rayan Lakes.

At many parts of the Fayoum Governorate and around the two banks of the drains, some farmers irrigated their land by pumping water from the drain directly to the crop land when fresh irrigation water is unavailable. The uncontrolled application of drainage or low quality water affects not only the soil, but also virtually all the environmental elements. These conditions must have many restricted effects on soil and plant growth and crop productivity, especially under the long-term use (Farrag, 2003).

Most of the main drains at El-Fayoum Governorate are agricultural drains except one main drain namely El –Batts drain which considered an agricultural drain contaminated with sewage effluents. Therefore, using drain water in irrigating crop plants is a very serious concern for plant growth and their seed compositions used in human or animal feeding.

Water environmental pollution due to toxic heavy metals is a serious environmental and public health issue, thus the removal of heavy metals from wastewater has become a very important concern to maintain water quality standards and suitable for environmental and human health. The recovery of heavy metals is normally achieved by physiochemical processes such as: chemical precipitation, coagulation, chemical/ electrochemical reduction, membrane technologies, ion exchange and sorption. The main conventional method used in heavy metal removal from aqueous solutions or soils involves high operational costs, and in many cases, it is insufficient to meet strict regulatory requirements or ineffective and expensive when the heavy metals in the wastewater at low concentrations. (Gupta *et al.*, 2000; Yun *et al.*, 2001; Seheng *et al.*, 2004; Horsfall and Spiff, 2005). As a result, alternative, inexpensive and effective technologies are in high demand. The use of biological materials, including living and non-living micro-organisms to remove and recover toxic or precious metals from wastewaters has gained popularity over the years due to good performance, availability and low cost of raw materials (Bunluesin *et al.*, 2007 and Ibrahim *et al.*, 2011).

Different biomasses can effectively absorb heavy metals, but recent research has shown that marine algae are more effective (Romera *et al.*, 2006). An additional advantage is that algae

especially green (Chlorophyta), brown (Phaeophyta) and red (Rhodophyta) grow exclusively in salt water (Romera *et al.*, 2008).

In these algae, the largest amount of cell wall content consists of mainly alginate and some sulfated polysaccharides (Figueira *et al.*, 2000 and Gupta *et al.*, 2000). Alginates, usually calcium and sodium salts are present in a gel form in the cell wall which appear very porous and easily permeable to small ionic species (Da Costa *et al.*, 2001).

In Egypt, wheat (*Triticum aestivum* L.) and faba bean (*Vicia faba* L.) are two important winter crops and they can be considered as one of the main source of carbohydrate and protein needed for most of the Egyptian population feeding and consumption. Irrigation water quantity and quality play a vital role in the two crops production.

This study is conducted to investigate the effects of irrigating wheat and faba bean plants with low quality water contained different concentration of heavy metals before and after algal treatments on germination percentage, seedling enzymes activity, some growth parameters and leaf pigments at two growth stages, total carbohydrate and protein content of seeds and the concentration of heavy metals in seeds at maturity.

To achieve these targets the following steps were adopted:

1- Collection of different marine algal species from the coast of Alexandria, Egypt.

2- Estimation of pH values, contact time and biomass dosage to choose the pest algal species which gave higher absorption capacity of heavy metals in aqueous solutions.

3- Preparation of algal powder column for bioremediation of heavy metals from low quality water.

4- Determination of the final percentage germination and seedling enzymes activity of plants irrigated with non- algal treated water (low quality water) and algal treated water.

5- Planting wheat and faba bean seeds in big pots and irrigation with non- algal treated water and algal treated water until maturity to determine growth measurements, leaf photosynthetic pigments, as well as total protein, carbohydrate and heavy metal content in seeds at harvesting time.