	Title: Phytoremediation for Treatment of Brackish Water from Reverse Osmosis Plant
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Abstract:

Brackish water as byproduct from Reverse Osmosis plant (RO) after desalination process, this considered as environmentally impact from RO usage. It contains significant concentrations of dissolved salts ions such as Na+, Cl- , Ca2+, Mg2+, K1+, SO2-, and CO32- as major ions. Total Dissolved Salts (TDS) of these ions ranged from (5000 mg/L -10000mg/L). Depletion of brackish water in unfriendly environmental ways causes plant growth inhibition due to osmotic stress caused to plant and soil; also will limiting the fields for agricultural use in the country. Phytoremediation are one of the methods can be used for water and land salt remediation.

In phytoremediation techniques plants are used to extract, immobilize and degrade contaminants. The phytoextraction of salts relies on the uptake of ions into plants biomass during brackish water irrigation process. Salts ions are up taken by plants, sequestered and harvested as a plant biomass. This method removes the salts from soil and/or brackish water and leaving the environment clean. xx

As high salt concentrations inhibit plant growth, Plant Growth Promoting Rhizobacteria (PGPR) were found to improve plant growth by lowering production of stress ethylene compound within plants, thereby increasing the biomass and photosynthetic activity.

In this research, PGPRs were implemented to investigate the efficiency of phytoremediation techniques for treatment of generated brackish water. Two strains of PGPR (UW3, *Pseudomonas putida*. UW4, *Pseudomonas putida*) were isolated from natural compound and obtained from Prof. Glick –Waterloo University – Canada, had been selected to be used with two plants: Barley (*Hordeum valgare* L.) and Malt plants (*Panicum maximum Jacq*.). Trials include treatment of these plants with PGPR and without PGPR in order to study the effects of PGPRs on the plant responses toward brackish water irrigation. All trials were carried in a designed green house.

The results showed that PGPRs had significant effects on plant growth (biomass), photosynthetic activity, membrane stability, and root and shoot lengths increase under salt stress by (compared to control trials treated without PGPRs and irrigated with fresh water and brackish water.

Greenhouse studies showed that plants treated with PGPRs and irrigated with brackish water increased significantly in biomass percentage for trails treated with fresh ware , 6000 mg/L of brackish water, 10000mg/L of brackish water related for Treated Barley seeds with UW3 (237.31%, 249.40%, 156.11%) and for Treated

Barley seeds with UW4 (156.11%, xxi

237.31%, 288.83%) and for trials treated with UW3 and UW4 (128.12%, 267.67%, 288.56%) compared to control trials without PGPR irrigated either with fresh water (dd H2O) (100%), or 6000 mg/L (8.98 %) and 10000 mg/L of brackish water (150.08%). It was noticed that the PGPRs treated plants had (283%), increase in their root and shoot length (respectively). Salt ions accumulation was found to be increased in shoots (159.09mmol, 179.73mmol) /0.114m2 of pots. TDS for decant water decreased to reach (0.101 mg/L). Electrolyte leakage assay showed that plant treated with PGPRs resulted in same values for trials treated with fresh water, less electrolyte leakage from membrane equal to 304 mg/L.

In addition, the several chlorophyll a fluorescence parameters, Fv/Fm, Y (II), and QN obtained from Pulse Amplitude Modulation (PAM) fluorometry showed that treated plants with PGPRs resulted in improvement in their photosynthesis under brackish water.

The novel results of this research study that carried for the first time where PGPRs *Pseudomonas putida* (UW3, UW4) had been used for improving the phytoremediation activities of two salt tolerant plants: Barley (*Hordeum valgare* L.) and Malt plants (*Panicum maximum Jacq*.) had showed a very clear and significant improvements of high salt uptake and thus high phytoremediation activities of these plants once they were treated with PGPRs. The results of this research will be considered as an outbreak in the phytoremediation science and future applications.