Research Paper

Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

Bioprospecting of Biochemical Parameters of Wheat Under Salinity Stress After Bioferilizer Treatment

Biology

KEYWORDS : Bioferilizer, Plant growth promoting bacteria, Salt stress, Compatible solutes

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ABSTRACT

Microbial inoculums termed as 'Biofertlizers' are gaining a lot of interest now a day for improving the plant growth and productivity as a alternative to chemical fertilizers and pesticides. In developing countries like India, agriculture is an important sector for economy. However increasing soil salinity causes a major loss of agricultural economy. The present study demonstrated the efficacy of biofertilizer Enterobacter cloaceae to growth improvement by analyzing the various biochemical parameters of wheat under various level of salinity stress. Microbial isolate was isolated from salt rich lake 'Sambhar lake' to growth improvement and development as bioferilizers for plants growing around the salt rich region. The seeds of wheat were treated with microbial inoculums with salt stress and the observed changes in biochemical parameters were analyzed after 15 days of study period. Results illustrated that plants treated with Enterobacter cloaceae showed significant improvement in various biochemical parameters responsible for plants sustainability as compared to untreated control plants.

Introduction

Salinity is one of the major abiotic stresses adversely affecting modern agriculture and constitutes a major problem worldwide. It is estimated that more than 6% of the world's total land area is salt-affected (Bui, 2013). Increasing salinity in the soil make it harder for plants root to extract water and therefore have an immediate effect on cell growth and associated metabolism. Accumulation of salinity induced toxic ions affects the plant functionality in several ways. In addition, several biochemical and physiological processes like protein synthesis, lipid metabolism, photosynthesis, ionic homeostasis and nitrogen fixation are severely affected by salinity. One approach to solve the salt stress problem is the use of plant growth-promoting bacteria as bioferilizers. Use of microbial inoculums or biofertilizers is of great agricultural importance as they are cost effective and renewable source of energy for plants and also helps in reducing the use of chemical fertilizers for sustainable agriculture (Rana et al., 2013). Many of the plant growth-promoting bacteria have been reported to colonize the plant rhizosphere and confer beneficial effects by various direct and indirect mechanisms. Term plant growth promoting bacteria was first introduced in 1978 by Kloepper and colleagues to a group of beneficial bacteria that promote the plant by enhancing the acquisition of nutrients, production of of phytohormones, nitrogen fixation, siderophore production and indirectly by antibiotic production, secretion of lytic enzymes. The effectiveness of these plant growth promoting bacteria as biofertilizers to mitigate the adverse effect of salinity stress has been reported in several vegetable and other crop plants (Saravankumar and Samiyappan 2007).

To maintain osmotic adjustment under salt stress, plants have developed complex physiological and biochemical mechanisms to accumulate the compatible solutes (osmolytes) for maintaining the intracellular osmotic homeostasis (Gupta and Huang 2014). One of the important osmolytes, proline contribute to osmotic adjustment by detoxifying ROS induced oxidative damage (Gupta and Huang 2014). Following inoculation of beneficial bacteria enhanced production of proline (Ait Barka et al. 2006) was observed in abiotically stressed plants. Besides of proline other molecules like glycine betaine, total soluble sugars and total protein content also helps to survival of plants under salinity stress. Previous reports suggested that inoculation with biofertilizers enhance the salt tolerance in tomato (Mayak et al. 2004), red pepper (Siddikee et al. 2011) and groundnut (Saravanakumar and Samiyappan 2007).

Salt induced land degradation led to a major drop in wheat grain yield ranged 20-43% with an overall average loss of 40%. Wheat is grown in India under sub-tropical environments during mild winter which warms up towards grain filling stages of the crop. Wheat is one of the most important cultivated cereals second to rice in importance as staple food in India. However in different parts of India, productivity is affected by increase in salinity as it lowers osmotic potential leading to decreased water availability. Therefore we may speculate that development of microbial inoculants as biofertilizers from extreme condition could be beneficial to mitigate the salt stress to the plants growing in saline habitat. While a number of studies have demonstrated the role of microbes in maintaining the plant growth under unfavourable conditions, little is known about the inoculation of *Enterobacter cloaceae* on the biochemical parameters of wheat under different level of salinity. Therefore the aim of the experiment was to increase the productivity of crops with the significant changes in various biochemical properties with the help of biofertilizers.

Materials and methods

Bacterial inoculum and seed treatment

In-vitro pot study was conducted to evaluate the potential of microbial inoculums as biofertilizer. Sterilization of soil was done by autoclaving at 121°C for 1 h for three consecutive days to kill the entire microorganism and their spores. The surface sterilized wheat seeds were treated with biofertilizer *Enterobacter cloaceae* and kept for gerimantion in plant growth chamber. After sprouting, plantlets were treated with salt stress 150mM, 175mM, 200mM. Bacterized seeds were sown in plastic pots filled with soil (300g per pot) in triplicates in a growth chamber with 16:8 photoperiods up to 21 days at 28 ± 2°C. Control seeds without any treatment were also used in the study. Hoagland media supplemented with salt (150mM, 175mM, 200mM) was used for providing the nutrient as well as imposing the salt treatments. After 15 days of study period, the biochemical parameters such as total proline content, malondialdehyde content, level of total soluble sugar and total protein content were studied by standard methods.

Results and discussion

Wheat seed treated with bioferilizer *Enterobacter cloaceae* showed significant improvement in biochemical parameters as compared to control plants. Plants treated with bioferilizer showed enhancement of proline, total soluble sugar, total protein content and decrease in malondialdehyde. Our results are agreed with the previous finding of Ruffino et al. (2010) and Nabti et al. (2010).

Table 1: Effects of biofertilizer *Enterobacter cloaceae* on proline content

Treatment		Proline (µmol/g FW)		
Salt (0)		Salt (150mM)	Salt (175mM)	Salt (200mM)
UN-INC	3.17 ± 0.24	5.4±0.27	6.70±0.19	8.10±0.22
SL-12	4.90±0.18	6.80±0.21	8.27±0.26	6.18±0.17

Table 2: Effects of biofertilizer *Enterobacter cloaceae* on total soluble sugar

Treatment		TSS (mg/g FW)		
	Salt (0)	Salt (150mM)	Salt (175mM)	Salt (200mM)
UN-INC	4.18 ± 0.17	3.94±0.21	3.54±0.20	2.96±0.18
SL-12	5.47±0.19	5.19±0.23	5.70±0.15	4.10±0.22

Fig.1 Effects of biofertilizer *Enterobacter cloaceae* on MDA content in wheat plant

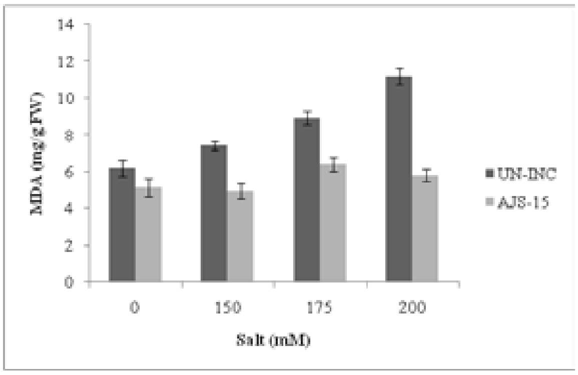
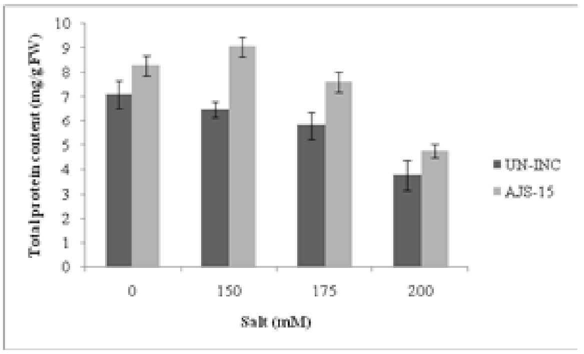


Fig. 2 Effects of biofertilizer *Enterobacter cloaceae* on total protein content in wheat plant



Conclusion

Wheat seeds treated with biofertilizer *Enterobacter cloaceae* showed significant increase in various biochemical parameters under salinity stress. The specific resistance mechanism of compatible solutes to a wide range of abiotic stresses is still not fully understood, however these molecules significantly contribute to osmotic adjustment, stabilize lipid membranes, stabilising protein during stresses etc. Therefore, use of bacteria with such features could be used as biofertilizer to combat saline stress.

Acknowledgement

We are grateful to Department of Biotechnology Govt. of India, New Delhi for their support by providing the fund for carrying out the research work.

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