Establishment and validation of high-throughput screening protocol for salinity tolerance in lentil

Hossein Valipour Kahrood[1]
Garry Rosewarne[2] and Sukhjiwan Kaur[1]

[1] Department of Jobs, Precincts and Regions (DEJPR), AgriBio, Centre for AgriBioscience, Bundoora, Victoria, Australia 3083
[2] Department of Jobs, Precincts and Regions (DEJPR), The Grains Innovation Park, 110 Natimuk Rd, Horsham Victoria Australia 3400

Salt toxicity is recognised as a major constraint to crop production in Australia where c. 32 million hectares of cropland is affected by salt. Accumulation of salt causes inhibition of plant growth and reduces the ability for water and nutrient uptake ultimately resulting in reduced yield. We have developed high-throughput screening protocols using Lemnatec systems that can be deployed in the breeding programs for routine screening of salt tolerance.

In this study, a range of lentil breeding lines with varying levels of salt tolerance (ILL2024, CIPAL 1522, tolerant; PBA Bolt, PBA Hurricane, medium tolerant and PBA Ace, PBA Jumbo2, sensitive) were treated with various salt concentrations; 42.5, 85 and 127.5 mmol NaCl, in LemnaTec system at Plant Phenomics Victoria Bundoora. Imaging was performed at the start of the treatment, then every second day for six weeks. The image scores were used to measure plant pixel area (as a proxy for plant biomass) and plant senescence (as a proxy for plant health). Concordant results with traditional phenotyping were obtained and an optimal concentration of sodium chloride discriminating between the breeding lines was identified.

In a follow up experiment, approximately 190 advanced lines from lentil breeding program including 12 check lines were selected for salt screening in a partial replication (20%) trial. Each of these lines were tested under two conditions, control (zero salt) and treatment (100 mmol NaCl, identified in the pilot study). At the conclusion of the experiment, the above ground biomass of the plants was harvested, oven dried and weighed and correlations to the image scores were drawn. Furthermore, to understand mechanism of salinity tolerance in lentils, leaves (including lower leaves and young shoots), stems and roots were sampled, oven dried and chemical elements including sodium (Na) and potassium (K), as well as P, S, Ca, Mg, Cu, Zn, Mn, Fe, B, and Al were measured by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES)