Salt tolerance in barley

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Key findings

- The absence of sodium and chloride significantly contributed to salt tolerance and grain yield production in barley varieties examined in this trial.

Introduction

Broadacre cropping in Australia is based on rain fed systems in a semiarid environment, where the efficient uptake and use of water is the main driver of productivity. However, more than 60% of the 20 million ha of cropping soils in Australia are sodic. Saline subsoils adversely affect the ability of crops to use subsoil water and this imposes a significant constraint on productivity.

The aim of this work was to examine differences in salt tolerance between barley varieties.

Materials and Methods

Field study

Plot size	1.4 x 10m	**Fertilizer**	DAP @ 60 kg/ha + 2% Zn Urea @ 50 kg/ha 10th August
Seeding date	12th May 2009		

A field trial was conducted to assess the genotypic variation among 13 barley varieties in response to salinity stress at Hart.

At Zadoks growth stages (ZGS) 45 (booting), 65 (50% anthesis) and 92 (grain ripe), five randomly-selected plants from each plot were sampled. The plants were washed and separated into the upper and lower leaves of the main stem for dry weight measurements, ionic analysis, leaf osmotic potential and organic solutes.

At ZGS65, ten soil cores were randomly taken from a soil depth of 0–100 cm. Electrical conductivity (EC_e), pH, soluble sodium, calcium and magnesium were determined in a saturated paste extract.

Results

There was a wide range in plant grain yield and sodium and chloride concentrations among the 13 varieties. Grain yield ranged from 3.3 t/ha in Maritime to 5.5 t/ha in Capstan. Significant varietal variation occurred in sodium and chloride concentrations as well as osmotic potential of the flag leaf blade (Figure 2). Sodium concentrations varied widely, ranging from 345 to 556 mmol kg^{-1} dry matter. Also, chloride concentration varied about 1.5-fold ranging from 415 to 670 mmol kg^{-1} dry matter. Leaf sodium and chloride concentrations and osmotic potential were lower for the higher yielding varieties.

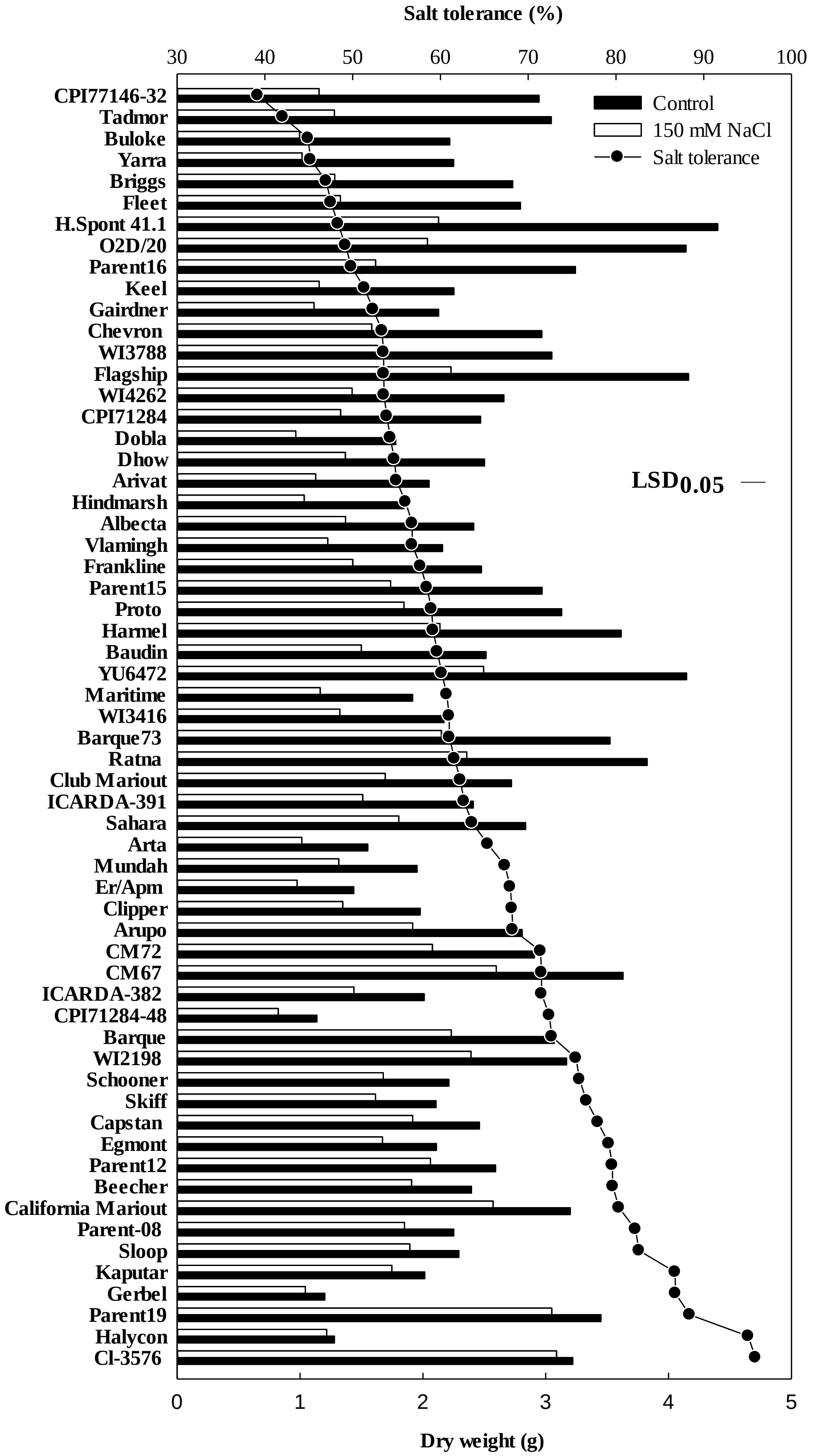

Figure 1. The range in dry matter production (vertical bars) and salinity tolerance (line-scatter plot) of 60 genotypes of barley grown in supported hydroponic system for 7 weeks. The salt tolerance was calculated as the ratio of dry matter production under 150 mM NaCl treatment (white bars) to control condition (black bars). The coefficient of variation of experiment was 4.15%. Values are means (n=4).

Differences in dry matter production and salinity tolerance have been shown to occur between different barley varieties as illustrated in Figure 1. Whilst the results shown are for 60 varieties grown under hydroponic conditions, they do nonetheless illustrate the range of differences which potentially exist between the 13 varieties included in the Hart trial.

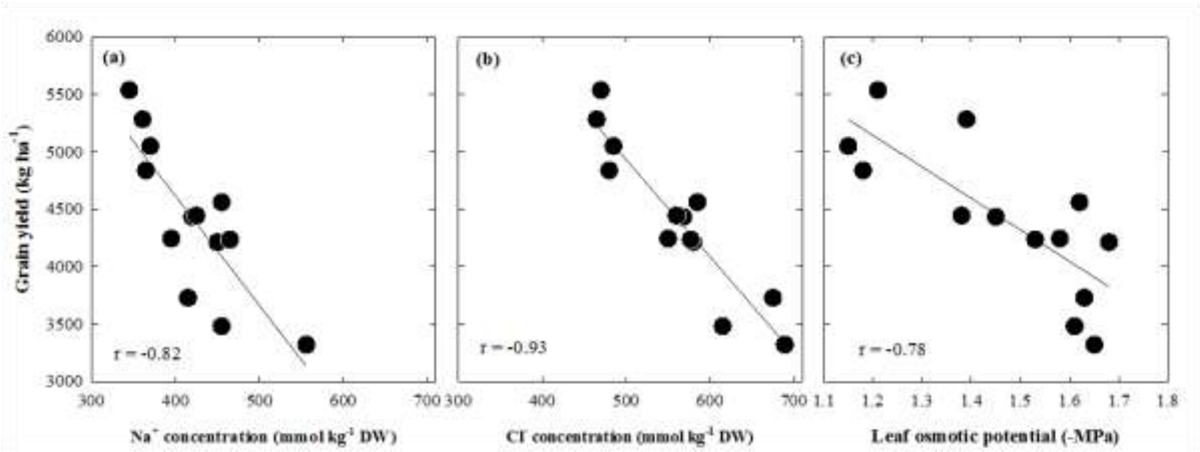

Figure 2. The relationship between grain yield and leaf concentration of (a) Sodium (Na^+) concentration, (mmol kg^{-1} DW); (b) Chloride (Cl^-) concentration, (mmol kg^{-1} DW); and (c) leaf osmotic potential (-MPa) of 13 barley genotypes grown at Hart site in 2009. The results are from youngest emerged leaves at ZGS 65. Fitted curves are derived from linear regression. The horizontal and vertical bars are LSD at 95% for the ion explanatory and dependent variable respectively. Values are averages (n=4).

Acknowledgements
This work was supported by a grant from the Grains Research and Development Corporation and by the University of Adelaide.