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Combined effects of leaching fraction, salinity, and potassium content of waters on growth and water-use efficiency of wheat and barley

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Abstract

Wheat and barley seedlings growing in pots in a greenhouse, with a non-saline sandy loam soil were irrigated, by saline waters, S_1, S_2, and S_3, having $EC_i = 3$, 9, and 15 mS cm^{-1}, respectively. Each solution has three potassium concentrations, $K_1 = 6$, $K_2 = 11$, and $K_3 = 16$ meq L^{-1}, and all incorporated N (90 mg L^{-1}) and micro-nutrients. Irrigation was provided to realize 0.2 and 0.5 leaching fractions (L).

At maturity, dry matter of plant tops (Y), grain yield (G), and evapotranspiration (ET) of both crops responded significantly to the S, L, and K treatments. There were different interactions, however, between the crops indicating some effect of plant species. In both, a decrease in Y with increasing salinity was associated with a corresponding decrease in ET. In the most saline S_3 treatments, where the available water to plants was the lowest, an ample K supply produced substantial improvements in salinity tolerance of both crops. Under these conditions, changes in Y and ET were independent of each other. Increasing K supply, reduced the rate by which Y, decreased with respect to S. Barley accumulated dry matter more efficiently (in terms of ET Y^{-1}, g per g) particularly under L = 0.2. This efficiency for both crops did not respond to the water salinity but rather to the potassium concentration of the waters.

The whole experiment was also carried out under two levels of phosphorus application (35 and 70 mg P kg^{-1} soil). Neither growth nor water-use efficiency were significantly affected by the higher rate of phosphorus application.

Introduction

It has long been recognized that adverse effects of saline irrigation waters on plants can be offset by the application of additional water over and above that simply required for plant transpiration. Also, it is well known that potassium and calcium in substrates can have a very definite influence on transpiration and water uptake by plants (Biebl, 1958). A better knowledge of their interactive effects on salt-stressed plants may contribute to better agrotechniques for irrigated agriculture. This is of paramount importance for cropping in arid and semi-arid regions where water supplies of high quality are limited and, even gradually deteriorating.

To date, a clear and comprehensive understanding of the deleterious effects of salinity on plant growth has been lacking. Osmotic and nutritional effects of salinity arise (Mashhady *et al.*, 1985). Enhancing of plants' ability to tolerate salinity through fertility has been exploited to a certain extent. The problem is complex and the results, so far, are somewhat contradictory (Adams and Doerge, 1987).

In this work, wheat and barley yield trials