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Potassium use efficiency by wheat and barley grown in grey sand with saline or non-saline conditions

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Currently over 1 million hectares in the south-west agricultural area are severely affected by salinity, and there is increasing incidence of potassium (K) deficiency. Leaching of K especially in sandy soils is also a significant contributor to poor K-use efficiency in cropping system. We conducted two glasshouse experiments to investigate K-use efficiency by wheat and barley grown in grey sand with non-saline or saline conditions. In experiment one, plants were supplied with 15, 22.5, 30, 45, 75, 135 mg K kg^{-1} under non-saline conditions and grown to maturity. Shoot and root dry weights reached a plateau at 75 mg K kg^{-1} at most growth stages. Reduced shoot growth by K deficiency was best explained by reduced tiller numbers and the rate of development. Luxury K supply (135 mg kg^{-1}) greatly increased shoot K percentage compared with adequate K supply (75 mg kg^{-1}), but both treatments had similar seed K and N percentages and harvest index. Seeds were not properly filled under severe K deficiency, and had decreased seed size (13–18 mg) at moderate K deficiency, compared with 30 mg at adequate or luxury K supply. With K deficiency the shoot:root ratio increased. The greater effect of K deficiency on root growth may make low-K plants more vulnerable to drought conditions. In experiment two, plants were first supplied with 30 mg K kg^{-1} for 4 weeks to create moderately K-deficient plants, and then subjected to varying Na and K levels for 3 weeks with measurements of K and Na uptake, K substitution by Na and plant growth. Although high Na (300 mg Na kg^{-1}) reduced leaf numbers, applying moderate Na (100 mg Na kg^{-1}) to the K-deficient plants stimulated leaf development in barley cultivars. It also significantly increased tillers and shoot biomass, together with shoot Na accumulation, in the salt-tolerant CM-72. Root growth, relative to shoot growth, was enhanced by adequate K (75 mg K kg^{-1}) versus deficient K, but not by moderate Na. The substitution of K by Na was influenced by soil K and Na status and also the potential for Na uptake by the plant which seemed to be related to the salt tolerance of cultivars. The failure of moderate Na to stimulate root growth under K deficiency may expose the salt tolerant plants to greater water stress. Both experiments illustrate the potential importance of K nutrition to minimising water stress in cereals, but further testing of this proposition is needed in the field.