When a little salt is good for you — using salinity to improve crop growth

Soil salinity, mainly associated with sodium chloride (NaCl), severely affects about 1 million hectares of agricultural land in Western Australia. Potassium (K) deficiency also is increasingly common in this region due to greater removal of K in hay, grain and straw than fertilizer K input over many years.

There is increasing evidence that K plays a key role in alleviating a range of abiotic stresses: salinity, sodicity, drought and frost. Over the past four years, under the Grains Research & Development Corporation (GRDC) project “Managing potassium nutrition to alleviate crop stress”, we have been determining the interactive effects of soil Na and K levels on the main grain crops, wheat, barley and canola.

**Methods and results**

In glasshouse pot experiments, wheat, barley and canola were treated with low to high Na (25–300mg/kg of soil) at low or adequate K supply (30–40, 100mg/kg of soil). Shoot and root growth, photosynthetic gas exchange, K and Na uptake were measured.

High soil Na (100, 200mg/kg) greatly reduced plant growth in wheat, especially at low-K supply (40mg/kg). By contrast, low to moderate Na (25, 50mg/kg) eliminated K deficiency symptoms in the shoot (Figure 1) and increased root dry mass at low K supply. Low to moderate soil Na stimulated photosynthesis by increasing shoot K and provided more assimilates for root growth.

In barley (more salt tolerance than wheat), low-K plants with the treatment of 100mg Na/kg had more tillers and greater shoot dry mass than those with nil-Na (Figure 2). The substitution of K by Na, mainly in non-specific biophysical roles (e.g. osmoregulation and ionic balance), was influenced not only by plant K status, but also by the potential for Na uptake in roots and Na accumulation in shoots, which may also contribute to salt tolerance.

Leaf K-deficiency symptoms in canola were eliminated by adding 100mg Na/kg (Figure 3). At low-K supply, 100mg Na/kg also increased final shoot dry mass, pod number, seed number per pod and seed yield, compared with non-saline condition (Figure 4).
In the field, barley was grown under moderately saline and low-K conditions. Applying K increased K uptake but decreased Na uptake. Plant growth and grain yield increased with K supply, but the difference between the low- and high-K rates was relatively small, indicating partial K substitution by soil Na.

**Conclusions and recommendations**

Although soil salinity is a major limitation to profitable and sustainable agriculture, our study has shown that low- to moderate-Na can be beneficial to crop production on low-K soils which are becoming increasingly common in Western Australia. The partial substitution of K by Na may mean less K demand by crops.

In the Grey Deep Sandy Duplex Soil group (covering 1.5mil.ha) and deep sands (2.4mil.ha), low soil K coincides with moderate Na levels. Therefore, the management of K fertilization needs to consider not only soil K status and crop requirement, but also soil Na status and genotypic variation in the uptake and use of K and Na.

**More information**

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**References**