TOLERANCE OF SELECTED CROPS TO GYPSIFEROUS WATER ORIGINATING IN COAL MINES

by

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When I in awesome wonder considered all the plants Thy hands have made…

…my God how great Thou art!

"Through Him all things were made;
without Him nothing was made that has been made"
John 1:3

To my husband Hannes

who gave of himself in many selfless sacrifices to make this study possible

and

to our children Marié, Jakobie, Hannes and Willem

and their families

whom I love dearly

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ABSTRACT

The disposal of gypsiferous water, generated in coal mining operations, has become a problem in the Mpumalanga Highveld region in South Africa. As part of an investigation into the feasibility of using this water for irrigation, sand and water culture experiments were conducted in a glasshouse and growth chambers to determine growth responses of maize, sorghum, pearl millet, sunflower, soybean, cowpea, dry bean, wheat, rye, triticale, oats, barley, annual ryegrass, and lucerne cultivars to gypsiferous mine water in the germination, seedling and vegetative growth stages. *Germination* %'s were generally not affected. The *seedling growth* of maize, sorghum, pearl millet and lucerne was more sensitive and showed more significant cultivar differences than the seedling growth of soybean and the annual temperate crops. *Seedling growth curves* with increasing concentrations of Ca, Mg and SO_4 followed a similar pattern for most of the crops: where $CaSO_4$ was in solution, growth decreased in a linear manner, but above saturation concentrations with increasing gypsum crystal content, it *increased* despite decreasing osmotic potentials of the treatment solutions. The *vegetative growth* of sunflower, lucerne, dry bean and rye was more tolerant than seedling growth, but was more sensitive for maize and cowpea, and the same as seedling growth for sorghum, pearl millet, wheat, oats, triticale and annual ryegrass. It was concluded that the major property of this water that suppressed growth was the decreased osmotic potential. However, it is the '*effective*' osmotic potential (i.e., the average osmotic potential during the whole growth period) and not that of the treatment solutions, that was mainly responsible for the eventual growth. The 'effective osmotic potential' is determined by evapotranspiration and the *rapidity of gypsum precipitation*, which in turn may be affected by the growth rate, temporal, environmental and soil factors. *Sensitivity* of crops and growth stages is therefore related to its sensitivity to the external osmotic potential,

whereas *tolerance* both in the seedling and vegetative growth stages was found in crops primarily affected by the ionic effects of Na and/or Cl. Possible nutrient effects due to the high Ca and SO_4 need further investigation.

Keywords Salt tolerance, gypsiferous water, coal mines, crops, pastures, cultivars, growth stages

CONTENTS