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EVALUATION OF HUMAN URINE AS A SOURCE OF NUTRIENTS FOR SELECTED VEGETABLES AND MAIZE UNDER TUNNEL HOUSE CONDITIONS IN THE EASTERN CAPE, SOUTH AFRICA

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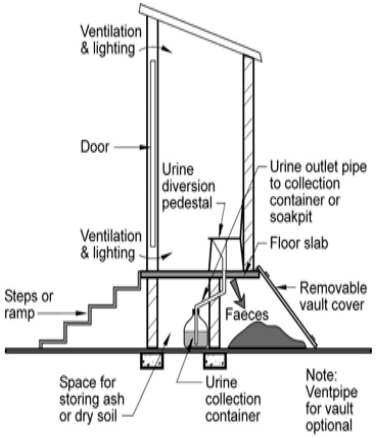
INTRODUCTION

- The introduction of urine-diverting toilets in South Africa has created opportunities for safer sanitation and the possibility of recycling human excreta, particularly urine, where these toilets have been established.



Introduction (contd)

- Urine has been used since ancient times to enhance the growth of plants, notably leafy vegetables.
- The nutrients in urine are in ionic form and their plant availability has been found to compare well with chemical fertilizers.
- Trials conducted in Zimbabwe showed vastly increased yields of different vegetables and maize, grown on sandy soils, as a result of the addition of urine (Morgan, 2003).

Effects of diluted human urine on cabbage growth

- A preliminary study in South Africa showed good response of cabbage and spinach to low rates of urine application but growth was depressed at higher rates of application.

Introduction (contd)

- Increased soil salinity was suspected as the cause for depressed growth at high rates of urine application.
- The present study was therefore carried out to further explore the fertilizer value of human urine using a wider range of urine application rates on crops with varying tolerance to salinity. Our hope is that positive results will catalyze the adoption of ecological sanitation in South Africa.

Materials and Methods

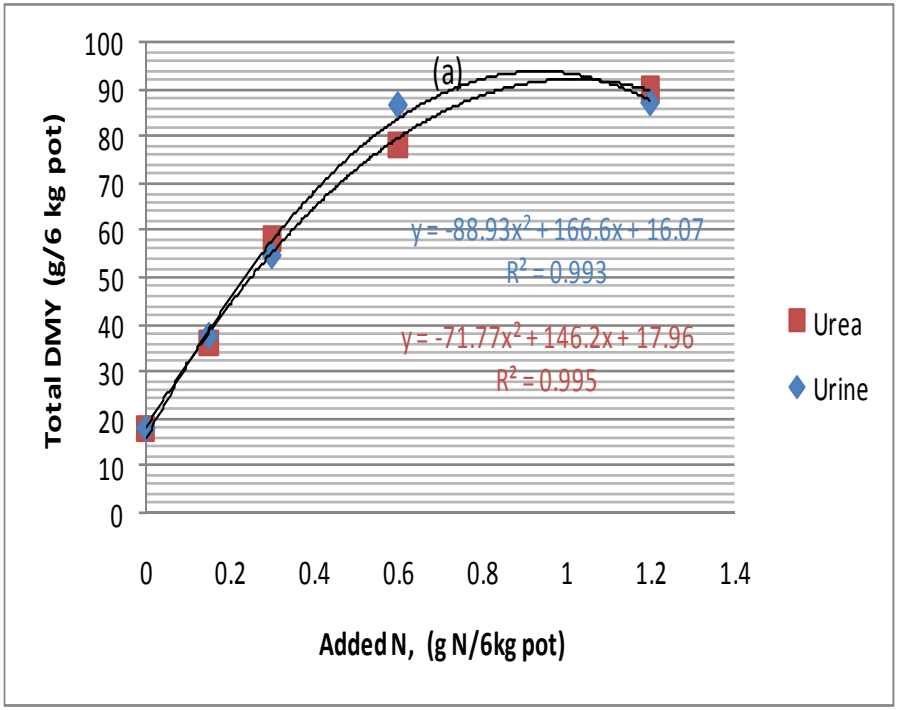
- The soil used was a Eutric Cambisol sampled from the plough layer of a cultivated land at Ntselamanzi location in Alice, South Africa.
- Urine was sourced from male student hostels at the University of Fort Hare.
- The urine contained 0.74% N, 1.62% K, 0.029% P, and 0.90% Na; and had a pH of 9.04 and an EC of 0.092 mS cm^{-1} after storage.
- The test crops were maize, tomato, carrot and beetroot.

Treatments

- **Treatments for the maize and tomato experiments were: 0, 20, 40, 80 and 160 ml urine or 0, 0.33, 0.66, 1.32, 2.64 g urea /6kg soil pot equivalent to 0, 0.15, 0.30, 0.60, and 1.20 g N/ 6kg soil pot or 0, 50, 100, 200 and 400 kg N ha^{-1}, respectively.**
- **Five maize seeds were sown into each pot and thinned to two seedlings per pot 10 days after germination while for the tomato trial, one seedling of the money maker variety was transplanted into each pot.**
- **Pots were regularly watered until harvest time (9 weeks for maize and 10 weeks for tomato)**

RESULTS

Figure 1: Effects of different rates urine and urea on maize total dry matter yield (DMY) and N accumulation in leaves and stems



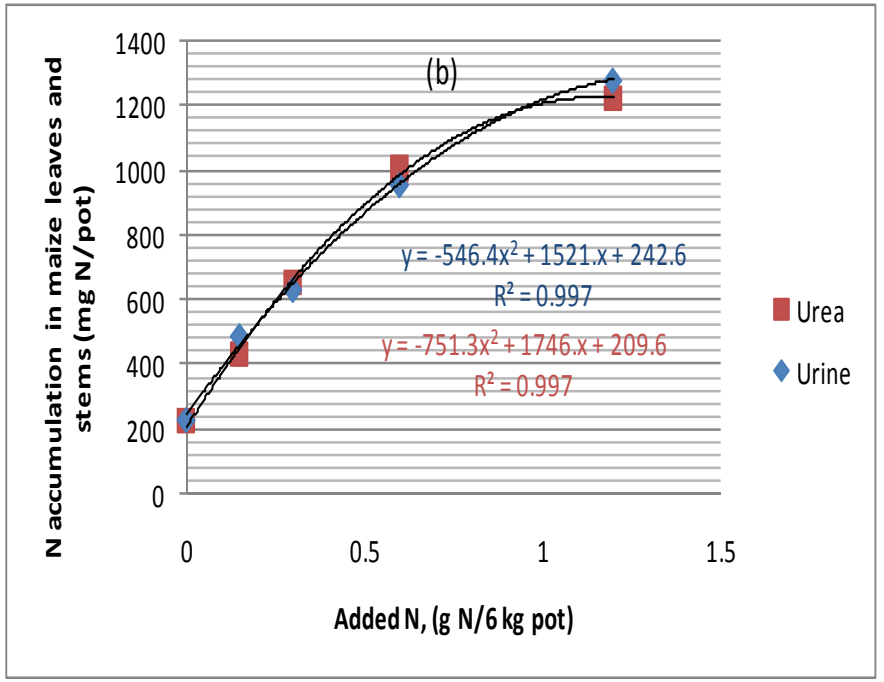
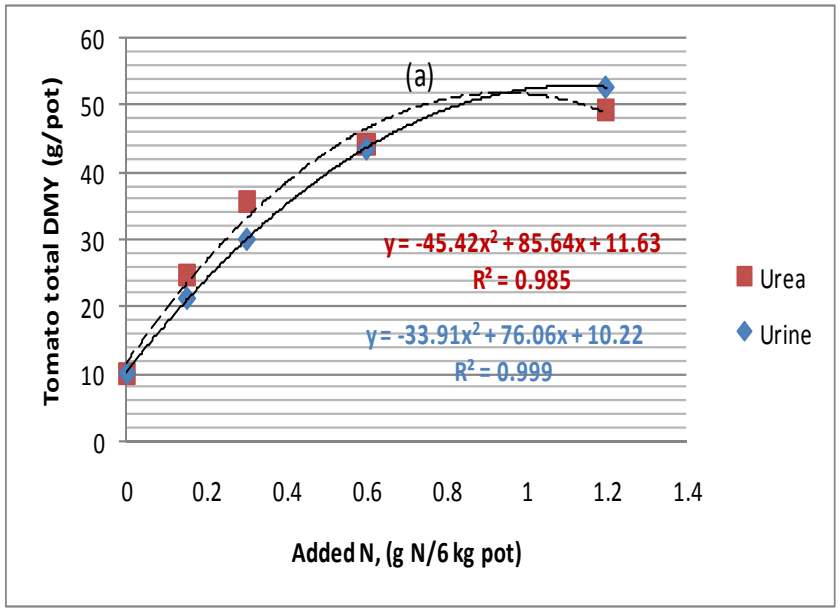


Figure 2: Effects of different rates of urine and urea application on tomato dry matter yield (DMY) and N accumulation in leaves and stems



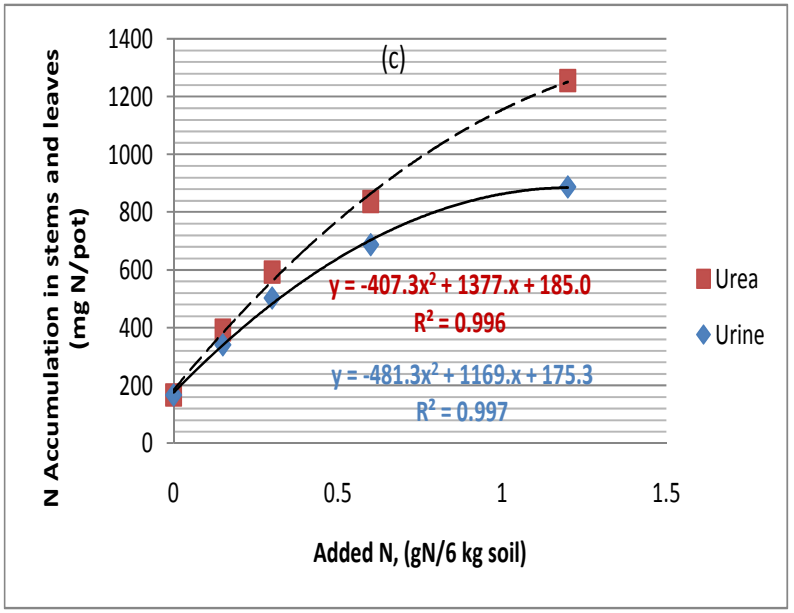


Figure 3: Effects of different rates of urine and urea application on tomato dry fruit weight per plant.

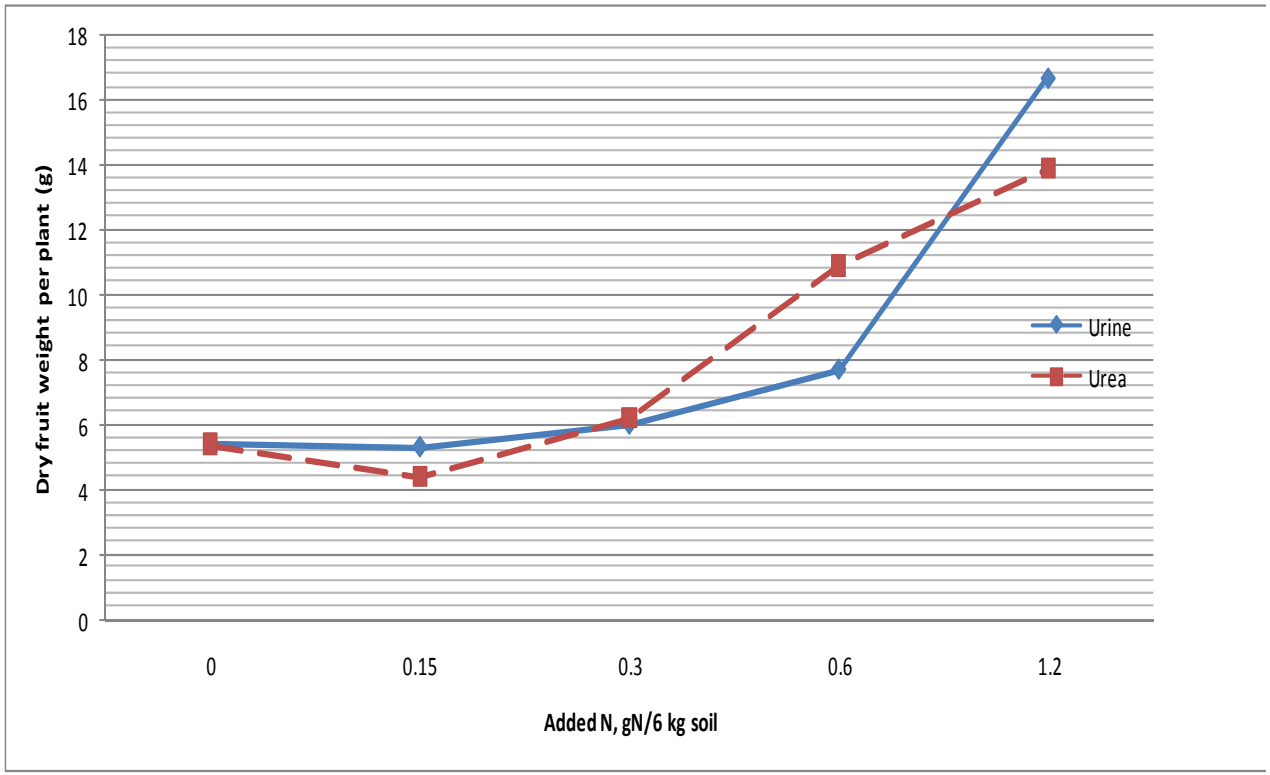
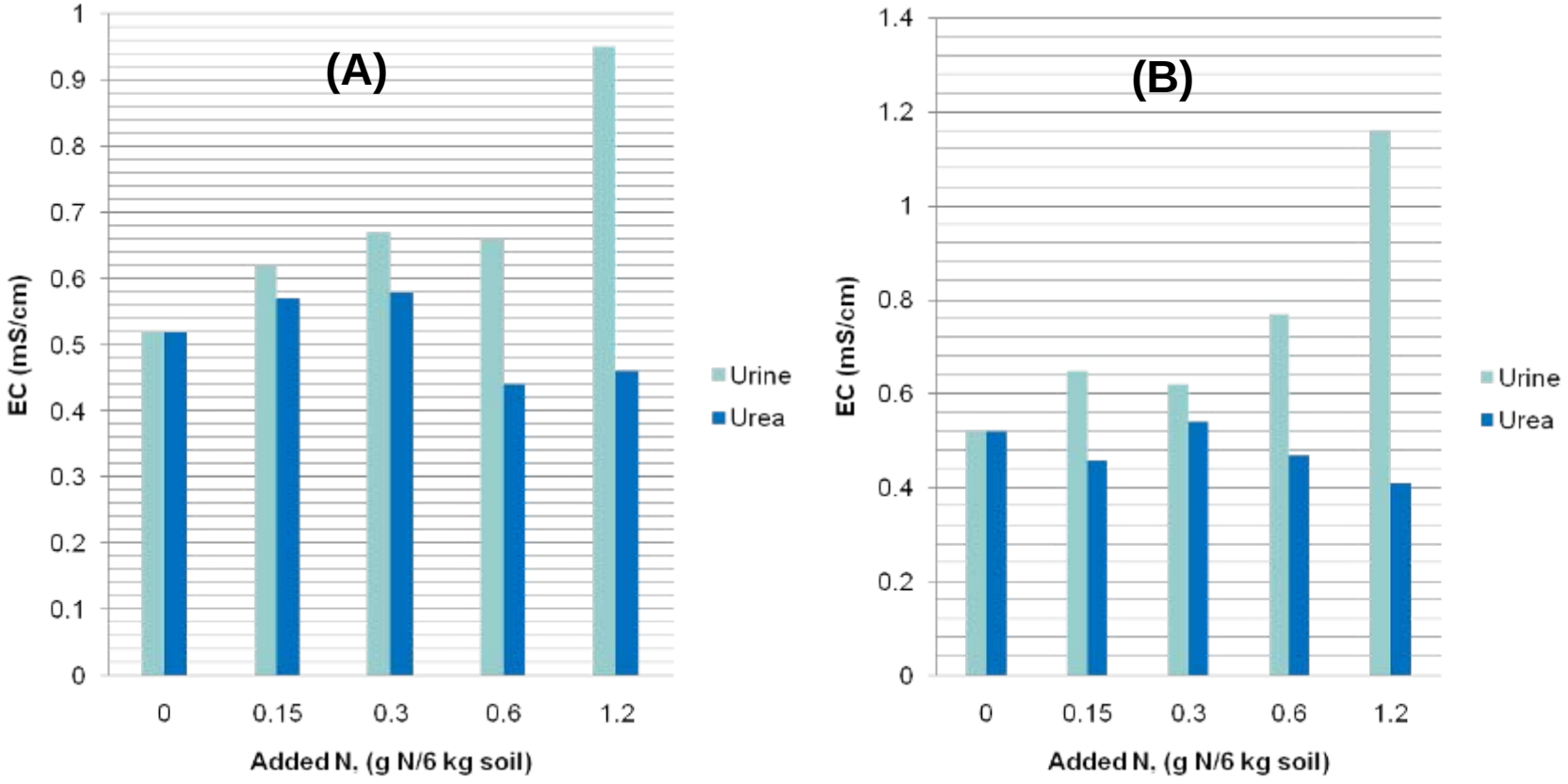


Figure 4: Effects of different rates of urine and urea added to maize (A) and tomato (B) on soil electrical conductivity (EC).



Effects of human urine as a fertilizer for carrot and beetroot production

- **Treatments for the carrot and beetroot trial were 0, 16.9, 33.8, 67.6, 135 and 270 ml urine /5kg soil pot equivalent to 0, 0.125, 0.25, 0.5, 1.0 and 2.0 g urine N /5 kg soil or 0, 50, 100, 200, 400 and 800 Kg N ha^{-1}, respectively.**
- **Treatments were replicated three times and arranged in a randomized complete block design in a tunnel house.**
- **Two seedlings each for carrot and beetroot were planted per pot. Watering was done regularly to maintain moisture at near field capacity.**
- **The beetroot and carrot were harvested at eight and five weeks after planting, respectively.**

Table 1: Leaf and root dry matter yield of beetroot and carrot as affected by different rates of urine

Urine rate (g N/ 5 kg soil pot)	Dry matter yield (g/ pot)			
	Carrot leaves	Carrot roots	Beetroot leaves	Beetroot roots
0	7.0a	2.2a	4.6c	7.3b
0.125	8.3a	1.3bc	7.7bc	7.7b
0.25	6.1ab	2.0a	9.1b	9.5b
0.5	6.7a	2.0a	9.5b	9.5b
1.0	6.0ab	1.6ab	15.3a	15.2a
2.0	3.4b	0.9c	13.1a	14.4a

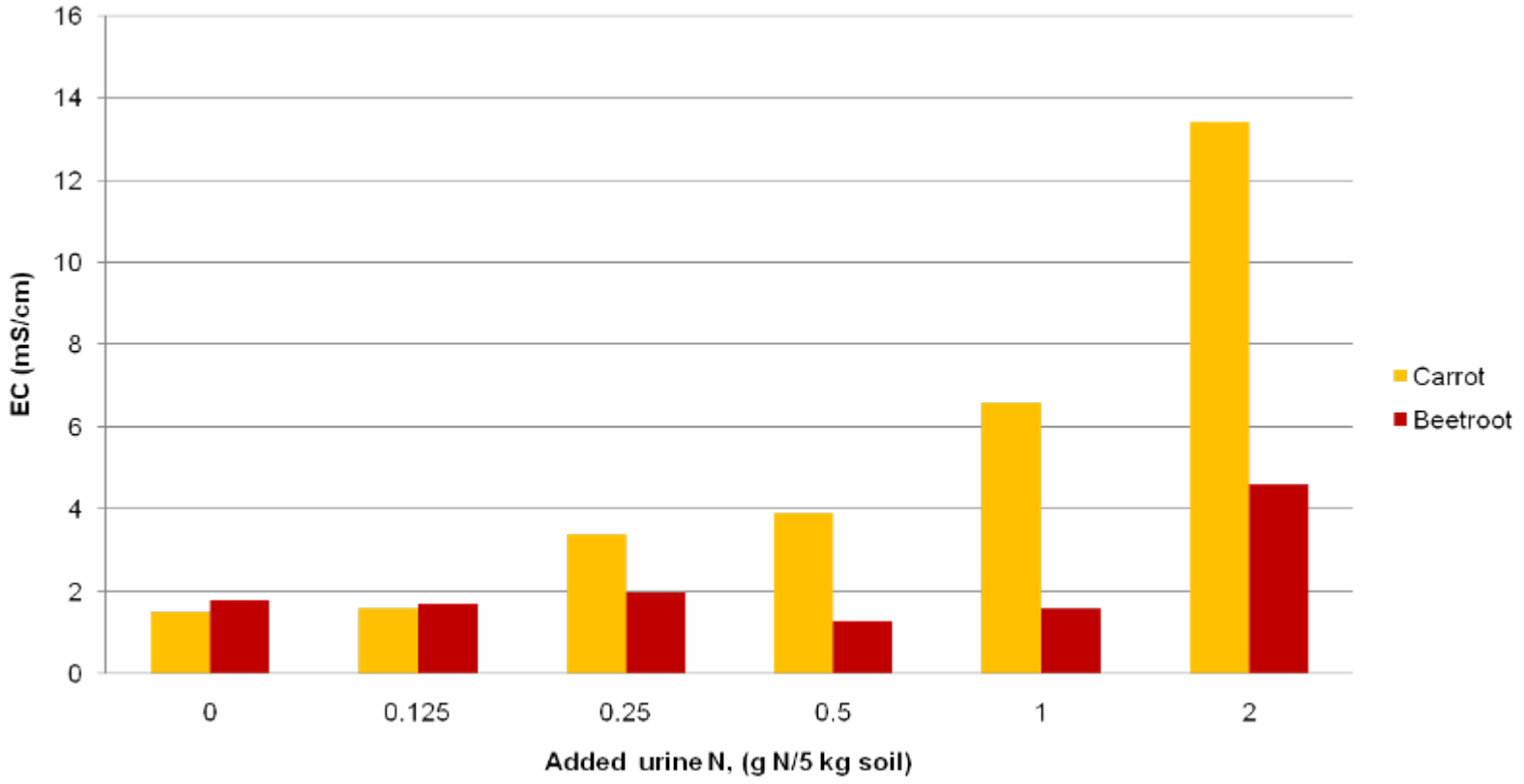
Means within each column followed by same letter or none at all are not significantly different at $P<0.05$.

Table 2. Nitrogen concentration in leaves and roots of carrot and beetroot

Urine rate (g N/ 5kg soil pot)	N concentration (%)			
	Carrot leaves	Carrot roots	Beet leaves	Beet roots
0	1.94c	1.00c	0.58c	1.25
0.125	2.32bc	1.71ab	0.55c	1.29
0.25	2.49ab	1.36bc	0.94bc	2.61
0.5	2.54ab	1.57ab	1.01bc	1.60
1.0	2.83a	1.30bc	1.45b	2.13
2.0	2.63ab	1.89a	2.47a	2.69
LSD at p=0.05	0.52	0.43	0.71	1.54

Means within each column followed by same letter or none at all are not significantly different at P<0.05.

Figure 5: Electrical conductivity (EC) of potted soil planted with carrot and beetroot as affected by rate of urine application



CONCLUSIONS AND RECOMMENDATIONS

- **This study has confirmed literature reports that human urine is as effective as inorganic N fertilizers as a source of nitrogen for crops.**
- **Soil salinization and high sodium accumulation in plant tissues, at high urine rates, suggested that the use of human urine should not be considered for salt-sensitive crops like carrot and for soils with salinity problems.**
- **The salinity status of soils that are regularly fertilized with urine should be monitored to guard against salt-build up.**
- **Beetroot or other edible salt-accumulating halophytes such as *Salicornia europaea* could be incorporated in the farming system as rotational crops to minimize the possibility of salt build-up.**

ACKNOWLEDGEMENTS

- We are grateful to the Water Research Commission (WRC) of South Africa for funding this study.