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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Water and agriculture

Water use and drought tolerance of selected traditional crops

A completed WRC-funded project provides much needed agronomic information about the response of selected indigenous crops to management under field and controlled environment conditions when water is limited.

Background

The agricultural landscape of South Africa in many ways reflects the dominance of modern crops that originated from outside of South Africa. Their rise has led to a decline in cultivation and knowledge about indigenous crops.

Recent interest in new crops globally and in South Africa (notably through the efforts of the WRC and the Department of Science & Technology) has increased.

The complexity of the problem posed by water scarcity, climate change and population growth requires unique solutions, or rather a new way of thinking. Indigenous crops have the potential to fill this gap and be possible future commercial crops.

However, what is required to propel these indigenous crops from the peripheries of subsistence agriculture to the promise of commercial agriculture is scientific research that produces databases for use by farmers.

Among the essential knowledge base is reliable information about water utilisation by indigenous crops with potential for commercialisation. This is especially important given South Africa's precarious water situation.

Identifying crops

The initial task of this WRC project was to identify and characterise indigenous and conventional food crops with agronomic potential in South Africa. This was done taking into consideration ***inter alia*** what can grow where under water scarce conditions, water requirement and crop responses to water stress, and production yield under water stress.

This was done through a detailed review of scientific and grey literature on indigenous and indigenised crops. The review was guided by the need to understand agronomic practices applied to these crops in South Africa and elsewhere, especially under dryland conditions.

The review identified the following crops as fitting this category: traditional maize landraces, wild watermelon, wild mustard, cowpeas, amaranth, pearl millet, Bambara groundnut, and taro. These crops were selected to include a wide range of crop groups from leafy vegetables, tuber crops, cereal crops and grain legumes.

Trials

A series of trials, including controlled, field and rain-shelter experiments, were conducted in three provinces of South Africa, namely KwaZulu-Natal, Free State and Gauteng. The overall objective of the experiments was to understand the agronomy of these crops and determine whether or not they were drought tolerant.

This included understanding their water use and water productivity. Modelling of selected crops to determine performance under dryland conditions was another secondary objective.

The secondary objectives allowed for a more detailed understanding of crop response to natural and simulated drought tolerance. To a limited extent, physiological indices such as seed germination and proline accumulation were also used to link crop characteristics to drought tolerance under field

and controlled environment conditions.

It was also in this context that a novel approach was used, one which sued the variegated nature of landraces as a basis of selecting for drought tolerance. This involved the use of seed colour as a possible selection criterion for drought tolerance in the cereal crops and grain legumes.

The studies on crop water use were diverse and represented current trends in determination of yield response to water availability. These included water use efficiency (WUE) and water productivity (WP) as distinct parameters indicating yield response to water availability.

Novel approach

A novel approach of the project was to select at least four crops that could be used to develop a crop model for indigenous crops. This was challenging because most existing models are based on the agronomy of major crops, with known responses to irrigation.

To achieve the objective of developing a new model, the FAO's AquaCrop model released in 2009 was selected and tested for the first time on indigenous crops. The advantage of the model is that it is less complex compared with other existing ones with regards to its requirements for parameterisation.

In addition, this model was particularly developed for the sole purpose of simulating yield response to water under limited water conditions. Furthermore, AquaCrop represents a new perspective in the understanding of crop water relations.

The selected crops for this part of the project were amaranth, Bambara groundnut, and pearl millet.

Conclusion

Over a period of five years, this study achieved the overall objective of providing agronomic information about the response of selected indigenous crops, indigenised taro and traditional maize to management under field and controlled environment conditions when water is limited.

The main findings of the study were:

- Seed coat colour as an important morphological characteristic
- Potential drought tolerance in maize landraces exists
- Wild watermelon is a potential drought tolerance crop
- Wild mustard tolerance to drought is moderate
- Cowpea drought tolerance is associated with seed coat colour
- Bambara groundnut drought tolerance is associated with seed coat colour
- Taro is an important dryland crop of the subtropics
- Pearl millet and amaranth studies explained the concepts of water productivity and water use efficiency of underutilised crops
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Future studies should combine plant physiology, agronomy and livelihoods to address agronomic potential and food insecurity.

Further reading:
To order the report, *Water-use and drought tolerance of selected traditional crops* (**Report No. 1771/1/13)** contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.