



## Multi-gene drought tolerance cassette

A combination of genes are expressed in concert by a single inducible promoter to produce a drought tolerance phenotype in crops. The individual genes and promoter are derived from a resurrection plant with each individual gene linked to the precursor by a small gene sequence. The gene cassette in plants confers tolerance to drought as well as a positive side effect, which is faster maturation. The market for drought tolerant maize alone is estimated at \$2.7 billion per year.

About 70% of worldwide crop productivity reduction is due to abiotic stresses which include drought, salinity, cold and extreme temperatures. These stresses, particularly drought as a result of climate change, cause extensive losses to agricultural crop production. For farmers, the effect of climate change is simply that the weather has become far more unpredictable, and extreme weather has become far more common, so drought tolerant crops are desirable.

Using a multi-gene approach, whereby a number of genes are arranged in tandem behind a single promoter makes it feasible to apply a polygenic (number of genes) approach to something as complex as drought tolerance where previously only single genes were applied. In such systems the specific combination and arrangement of the genes has an influence on the phenotype. This innovation relates to a specific combination.

A drought stress inducible promoter is used, which circumvents the problem with constitutive promoters where the target protein is continuously produced. Constant overexpression of genes can be problematic, resulting in unwanted phenotypic characteristics in transgenic plants. These negative traits can be attributed to the constitutive expression of the transgene. Expression of genes in large amounts at stages when they are not needed is metabolically taxing to the plant. Using Psap1D the protein is only produced when it is required thus avoiding any significant metabolic burden to the plant.

### Benefits

- Using Psap1D the protein is only produced when it is required thus avoiding any significant metabolic burden to the plant
- A number of genes are controlled by a single promoter limiting the amount of recombinant DNA
- A number of genes are directed at a complex trait rather than a single gene
- The system is functional in both monocots and dicots

### Market

- Seed companies
- Plant biotech sector

#### Keywords:

Genetically modified crops,  
Drought tolerance, Plant  
yield

#### Intellectual Property Rights:

Currently patent  
protection is being  
considered by UCT, whilst  
the details are maintained  
confidential. The strategy  
is to file a patent once  
field trials have progressed  
sufficiently

#### Contact:

Dr. Revel Iyer,  
Business Development  
Manager,  
Research Contracts &  
IP Services,  
University of Cape Town,

revel.iyer@uct.ac.za  
www.rcips.uct.ac.za



## Technical description

The technology incorporates a stress inducible promoter to drive expression of a multi-gene construct. This ensures that the transgenes are only expressed under stress conditions albeit relatively early (60-65% RWC).

The specific combination that produces a drought tolerance phenotype includes three genes. Two of the three genes can be disclosed:

- Prx2 is a type 2 peroxiredoxin obtained from the resurrection plant, *Xerophyta viscosa*. The primary substrate for the enzyme is hydrogen peroxide, while it has a high affinity for t-butyl hydroperoxide. Essentially the enzyme scavenges reactive oxygen species, which are especially generated during periods of stress
- Xv4 (Ald) is an aldose reductase obtained from *Xerophyta viscosa*. The enzyme is involved in the reduction of glucose to sorbitol. Studies have shown that transgenic plants expressing Xv4 (Ald) survived longer periods of water deficiency and salinity stress and exhibited improved recovery after rehydration as compared to the wild type plants.

The technology applied in order to generate a multi-genic transcript is referred to as the 'foot and mouth virus 2A peptide system'.

The multi-gene constructs have only been assessed in tobacco. However, a number of lines were generated from multiple transformation events. Approximately 60% of transgenic plants displayed a drought tolerant phenotype based on comparisons with wild type plants following a dehydration-rehydration assay.

## Intellectual Property Status

Currently patent protection is being considered by UCT, whilst the details are maintained confidential. The strategy is to file a patent once field trials have progressed sufficiently.

A commercial partner is sought to undertake field trials in a desirable food crop.

## About Research Contracts & IP Services

Research Contracts and Intellectual Property Services (RCIPS) acts as the liaison between UCT's research community and the private sector with regards to intellectual property, commercialisation and business development activities. RCIPS has helped to transfer numerous technologies from the university laboratories to industry both locally and internationally.