



NINTI ONE **CRC** **REMOTE ECONOMIC PARTICIPATION**

BACKGROUND RESEARCH SHEET:

BIOLOGY, CHEMISTRY AND GENETICS OF *SOLANUM CENTRALE*

SUMMARY PAPER KEY HIGHLIGHTS

- ▶ Bush Tomato horticultural production is a new food industry
- ▶ Genetic improvements to Bush Tomato can promote horticultural production, processing and marketing
- ▶ These developments take place in the context of safeguarding Aboriginal cultural heritage and intellectual property regarding Bush Tomato
- ▶ CRC-REP research aims to support sustainable business opportunities for growing Bush Tomato in remote Australia

Background

A new food industry has emerged from wild harvest and small farmed plots of Bush Tomato (*Solanum centrale*) fruit. As with any new industry, there are horticultural production and marketing challenges. However, industry development of bush foods has the additional issues of safeguarding Aboriginal cultural heritage and Intellectual Property associated with Traditional Knowledge about the uses and lore of bush plants. Prior research, which has focused on the horticultural opportunities of Bush Tomato, has investigated aspects of production and marketing of the fruit.

The Cooperative Research Centre for Remote Economic Participation (CRC-REP) is conducting research to develop horticulturally suitable genetic resources and information to help establish sustainable Bush Tomato business opportunities in remote regions of Australia.

Prior research shows that Bush Tomato plants may be genetically improved to make them better suited for horticultural production, for processing and for marketing. A certain amount of selection for horticultural production has occurred; however, limited scientific genetic improvement or plant breeding work has been conducted.

The longer term goals of genetic improvement are to enhance the crop performance and the quality of the fruit; a more immediate consideration for Bush Tomato is investigation of how alkaloid content affects fruit quality.



Biology of *Solanum centrale*

In the scientific study of *S. centrale*, greatest attention has been paid to the plant's botany and taxonomy. Of approximately 200 *Solanum* species recorded in Australia, 132 are endemic, that is, they are found only in defined locations and not anywhere else. The taxonomic relationships among these place *S. centrale* in the largest sub-genus, *Leptostemonum*, which covers some 450 species globally of approximately 1,700 species in the *Solanum* genus altogether. Within the sub-genus, *S. centrale* is located in the ellipticum group. Diploid, tetraploid and hexaploid forms (i.e. with multiple sets of genes) of *S. centrale* have been reported.

The species is an erect to sprawling herbaceous resprouting under-shrub of up to 45 cm height with grey-green entire foliage; fine (occasionally absent) prickles; modest purple 5-lobed flowers with contrasting yellow anthers; and rounded fruit to 2 cm diameter, light yellow at maturity then shrivelling to resemble a raisin retained on the plant. *S. centrale* flowers exhibit partial self-incompatibility and a high but apparently variable degree of out-crossing with cross-pollination in natural situations predominantly occurring between flowers in very close proximity. Pollination occurs mainly via transfer between flowers by native insect species. Dispersal of the seeds, mainly via ingestion, is predominantly by birds (emus in particular), mammals and people. The species is endemic and widespread in central Australia, occurring most commonly in the extensive adjoining regions of Northern Territory, South Australia, and also in Western Australia plus restricted locations in Queensland. It is found predominantly in sandy country associated with spinifex and is adapted to regular fire events by readily regenerating clonally from lateral roots.

In common with all desert plants, *S. centrale* is adapted to the rigorous environmental conditions of its natural range. For instance, in addition to clonal regeneration, the plant utilises symbiotic root fungal associations to improve nutrient uptake and exhibits considerable salinity tolerance. Flowering and fruit development respond to availability of water; then seed germination responds to fire; and seedling emergence awaits the optimal temperature regime for survival. Understanding these survival characteristics and constraints can assist in horticultural production of the species.





Alkaloids and chemistry of *Solanum centrale*

Six *Solanum* species are listed as Schedule 1 Prohibited Plants of the Australian Food Standard 1.4.4. Toxicity to humans associated with many *Solanum* species has been reported as due to alkaloid compounds of the 'solanum type'. These are widespread in Australian *Solanum*. The alkaloid incidence is variable depending on plant location, season, genetic background and plant maturity but tends to be higher in fruit than in other plant parts. Analytical evidence suggests that levels of these alkaloid compounds may be low in *S. centrale*, but the findings were inconclusive and required confirmation. Thus, *S. centrale* may contain varying quantities of alkaloids which, above a certain threshold, could pose a health risk to consumers of food products containing the fruit. While the risk may be slight, quality assurance and food safety standards require certainty about alkaloid content.

Alkaloid concentration appears to decline as *S. centrale* fruit matures, and it is likely that content varies as a result of post-harvest treatments and in plants sourced from different growing environments. As in other plants, it is anticipated that alkaloid composition of *S. centrale* would vary between plant varieties, yet this has not been reported to date. However, in mixed samples of *S. centrale* fruit analysed by this project with the highly sensitive NMR technology, negligible levels of the 'solanum type' alkaloids could be detected in mature fruit.

Analyses of the nutrient content of Bush Tomato fruit samples (most from variable wild sources) have been inconsistent. Iron content frequently appears to be high and *S. centrale* is one of only two bush food species to contain the important mineral nutrient selenium. Bush Tomato samples were found typically to be low in antioxidants, including vitamin C. In most respects, Bush Tomato presents no particular outstanding nutritional benefits for a commercial market, consumed as it is in small quantities; rather, its commercial appeal comes mainly from the piquant flavour it imparts as a component in processed foods, in which the alkaloid content probably plays a significant part.



Genetics of *Solanum centrale*

The results of genetic analysis of numerous *S. centrale* plants reveal a high degree of variation in forms within and between populations.

One DNA analysis showed that genetic diversity was high, yet with low levels of gene flow occurring between distant populations in their arid environment. Another DNA investigation revealed evidence of considerable polyploidy (multiple copies of genes), and this analysis confirmed high levels of genetic diversity in *S. centrale*. It was also shown that *S. centrale* appears to hybridise naturally with other related species (which could explain polyploidy).

An example of the potential benefits of DNA technology to the development of horticulture of *S. centrale* was the identification of a trait-specific DNA marker (for prickliness), which could aid in the selection of improved varieties.

In summary, although there is considerable information about the taxonomy and botany of *S. centrale*, there is limited knowledge about the genetics and chemistry of the species. This is unsurprising for a native plant species which has only in recent times attracted attention for its commercial potential. Nonetheless, a good foundation of technical investigation has been established, upon which new information is being built.

Further reading

Lee L. 2012. Horticultural development of bush food plants and rights of Indigenous people as traditional custodians - the Australian Bush Tomato (*Solanum centrale*) example: a review. *The Rangeland Journal*. 34, 4. pp. 359-73. <http://dx.doi.org/10.1071/RJ12056>.

Other technical summary papers in this series:

[Developing a Bush Tomato industry](#)

[Producing, harvesting and delivering the Bush Tomato product](#)

[Safeguarding Intellectual Property and Traditional Knowledge of Bush Tomato](#)

[Traditional Knowledge and the marketing of Bush Tomato](#)

Research Partners of the CRC-REP Plant Business Project

