# PROJECT SUMMARY

RURAL INDUSTRIES
Research & Development Corporation

## Commercial seed technology for tedera

### What the report is about

As is common practice for all novel forage species, seed harvest technology has to be developed so that the species can be readily adopted by seed growers and subsequently by the farming community.

This report describes research designed to support the development of commercial seed production technologies for tedera (*Bituminaria bituminosa* var. *albomarginata* ) and includes (a) glasshouse studies to measure seed yield response to different watering regimes prior to and during the period of flowering; (b) controlled field studies to measure the variability within the species for plant characters that influence seed production and (c) harvesting technologies to scale-up seed production for commercial application.

### Who is the report targeted at?

This report is targeted at scientists, plant breeders and, in particular, innovative farmers and seed producers who may become early adopters of tedera.

## Background

Tedera originates from the Canary Islands, where it is a component of native pastures grazed by livestock or has been cut and carried as hay for dairy goats.

Tedera has potential as a new domesticated perennial legume due to its ability to produce edible dry matter all year round, retain green leaf over summer and autumn with minimal leaf shedding and tolerate extreme drought and its adaptation to a range of soil and environmental conditions.

Over the period 2005 to 2009, tedera had been productive when established at five locations in south Western Australia with growing season rainfall varying from 330-600 mm, and across a range of soil types. In addition, tedera has demonstrated very good tolerance of, and recovery from, grazing.

When the production data from these preliminary, small scale studies is used in bio-economic models, the results reveal the potential of tedera to improve the profitability of permanent pastures and mixed cereal/livestock systems.

The main contribution of tedera is provision of green feed during summer and autumn when annual pastures are senesced, thereby decreasing or replacing the need for supplementary feeding of livestock.

As is common practice for all novel forage species, seed harvest technology has to be developed so that the species can be readily adopted by seed growers and subsequently by the farming community.

None of the existing projects in Australia or elsewhere in the world have conducted research into the technology required for commercial seed production. This research is a key issue for the seed industry and is fundamental for commercialisation and adoption of tedera.

## Aims/objectives

The objectives of this project were to:

1. understand factors influencing seed production in tedera
2. develop large scale and low cost technologies for harvesting and seed processing tedera.

The outcome of this project is information that will be utilised by the breeding program to select plants that will be suitable for multiple or single harvest technology as well as for a commercial harvesting and seed processing package. Efficient and low cost seed production will accelerate the adoption of tedera by the seed industry and wider farming community.

The final outcome will be an expansion of the mixed farming areas in southern Australia sown to perennials, with benefits to livestock and cropping industries.

## Methods used

This project consisted of glasshouse studies, field studies and evaluation of harvesting and seed processing technologies.

Two glasshouse experiments were undertaken to investigate whether it is advantageous for tedera seed production to reduce water availability during flowering (Experiment 1) or before flowering (Experiment 2). Such an effect could be achieved in commercial situations through a reduction in, or cessation of, irrigation.

It was hypothesised that a reduction in water availability would: 1) induce greater flowering and hence greater seed set; 2) result in a higher harvest index as the plant moved resources away from further growth and into seed production; and 3) allow a single harvest to capture a significant amount of seed due to more synchronous ripening of seed, along with greater seed set.

Tedera has an indeterminate flower habit and its peak of seed production occurs in November and December. The field studies were designed to investigate seed increase and characterisation of the variability amongst elite accessions of tedera for the time of flowering, flowering pattern, pod development, pod shedding and seed germination.
Seedlings were transplanted into the field into rows of plastic under irrigation, and seeds were subsequently hand-harvested. Measurements were taken on 10 individual plants per accession grown at Medina Research Station, all under the same growing conditions.

Researchers explored two types of machine harvesting methodology plus a hand-harvested control:

- Single harvest: cut and swath and then harvest with experimental combine (grain) harvester.
- Multiple harvests: "shaking and collecting" harvest
- Control: hand-harvested to measure the potential maximum yield.

Two experimental, small-scale harvesting machines were evaluated for multiple harvesting, where the harvester has to only take mature seeds from the plants with minimum damage to the immature seeds, flowers and leaves. These were a "vacuum harvester" (a similar concept to harvesters used for Australian grasses) and a "shaking and collecting harvester" (a similar concept to harvesters used for olives and grapes).

## Results/key findings

- Water stress generally brought forward the initiation of flowering and decreased the retention of flowers and pods. The effect increased with degree of water stress.
- Mild water stress had no impact on seed yield of any accession except T51, where individual pod dry weight and the proportion of green pod was slightly decreased.

- Mild water stress caused an approximate 50% reduction in shoot dry weight. However, as seed yield was maintained, it seems that the water and nutrients used to grow this additional shoot dry weight were not needed to maintain seed yield.
- All plants survived well, even after two months from removal of all shoot material at seed harvesting time, except those which had experienced the most severe water stress.
- Large variability was found among the accessions evaluated at Medina for all characters measured, including time of flowering, number of inflorescences per plant, seeds per inflorescence and seed retention.
- This large variability can be exploited through breeding to produce cultivars with outstanding seed production characteristics
- Tedera has a high seed production potential but requires attention to the management of the crop to achieve maximum yields.
- Tedera can be easily harvested in a single operation using a conventional grain harvester with minimal changes to machinery settings from that when harvesting cereals.
- Some accessions of tedera are very well suited to cut and swath and then harvest. Others will be more suited to spraying with a desiccant herbicide and then direct harvesting when dry.
- Seed cleaning/processing has been optimized.
- The field sites have been invaluable for gaining practical insights into the strategies required for commercial seed production of tedera.
- All this new knowledge was used for selecting plants with optimum seed production characteristics from the breeding program.

## Implications for relevant stakeholders

The key outcome of this work is that tedera seeds can be harvested at a commercial scale with existing technologies utilised for harvesting crops such as canola and wheat. This has important implications for farmers, seed growers and the seed industry, with the expectation now that seed costs can be constrained to levels below which they would otherwise present a barrier to the wider adoption of tedera.

The research has demonstrated large variability among accessions for all characters measured including time of flowering, number of inflorescences per plant, seeds per inflorescence and seed retention, indicating the potential though breeding and seed production management technologies to improve seed production in tedera.

This project contributed to the selection of elite lines based on seed production characteristics.

## Recommendations

To achieve commercially viable tedera seed yields, cultivars with high seed yield potential will be utilised, appropriate grazing management will be applied before flowering, and the right seed producing conditions and harvesting methods will be sought.

These recommendations are targeted for seed producers and early adopters of tedera. The ability to utilise conventional grain harvesting methodologies is an important outcome and further work is required to fine-tune these methodologies for the selected tedera cultivar(s).

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Pub. No. 15/011
ISBN: 978-1-74254-755-8