

## **New work on Nut Crops at the Waite Campus**

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### **New projects**

Three new projects, which address various aspects of nut production and improvement, will commence during 2000 at the Waite Campus. Two of the projects will introduce new researchers to the area, and so increase the overall number of personnel involved in nut crop research.

#### **Almond**

The almond breeding work, already established at the Waite, will be strengthened by two new grants. One is a continuation of a pre-existing Horticultural Research and Development Corporation (HRDC) grant, funded via the almond levy. This program has been expanded to include all of the improvement work, comprising rootstock trials and cultivar introduction, in addition to hybridisation, virology and tissue culture. The project is a collaborative initiative between the industry, the University of Adelaide and the South Australian Research and Development Institute (SARDI).

The second grant is a new Australian Research Council grant to conduct research into genome mapping for almond. Mapping is a powerful tool, which identifies molecular markers for important characteristics, such as disease resistance. The marker can then be used to screen seedlings in the breeding program. This saves time and resources, as susceptible seedlings can be identified and culled without the need to grow them to maturity for evaluation. Michelle Wirthensohn has been appointed to work on the mapping program. She has extensive experience in breeding and improvement of a range of crops, including olives and eucalypts, and the almond research program is fortunate to have her expertise. The project interfaces closely with the international *Prunus* mapping program, run by Pere Arus at the Institut de Recerca i Tecnologia Agroalimentaries at Cabrils in Spain. Michelle will spend six weeks in Pere's laboratory to learn the techniques they use, and ensure integration with the international effort. This project is also a collaborative initiative between the industry, the University of Adelaide and SARDI.

#### **Pistachio**

The third grant concerns research into pistachio canker disease. An industry supported HRDC project run by Cathy Taylor and Bob Emmett from the Sunraysia Horticulture Centre at Irymple has been underway for several years. Recently, the project team has been expanded to include Margaret Sedgley and Eileen Scott from the Waite. Margaret has worked on pistachio pollination and fruit set, and Eileen has expertise in plant diseases of both bacterial and fungal origin. Eileen has worked on many crop disease problems, including powdery mildew of grapevines, bacterial wetwood of poplar and collar rot of almonds and chestnut, and brings extensive new expertise to the program. Pistachio canker disease is the major problem confronting this new and expanding industry, and control measures are urgently required. The project will employ a postdoctoral scientist to enhance the team even further.

### **Conferences and visitors during 1999**

Research conducted at the Waite was presented at three major conferences in 1999, to growers at an industry day, and was discussed with visitors from overseas. A

paper on the almond breeding work was presented by Graham Collins at the GREMPA conference in Sanliurfa, Turkey, and a poster was presented at the Plant Breeding Conference held in Adelaide. Phillip Ainsley won the prize for best student paper at the International Association for Plant Tissue Culture and Biotechnology, Australian Branch 6<sup>th</sup> Meeting, held in Sydney, for his paper on almond regeneration for transformation. Chockpisit Chunnantapipat (Nid) won the prize for best student poster at the same meeting, for her poster on cryopreservation of almond. A poster paper on the almond work was presented at the 12<sup>th</sup> Biennial Australasian Plant Pathology Conference in Canberra and at the Horticultural Technical Conference in Adelaide. Chris Bennett organised an Almond Industry Seminar at the Waite in August, at which the latest research results were presented, and feedback from growers was encouraged. Dr Pere Arus from Cabrils in Spain visited the Waite after attending the Plant Breeding Conference in April, to commence discussions on the new collaboration on mapping. Dr. Raphael Assaf, a deciduous fruit production specialist from the Volcani Institute in Israel visited in August. He presented a lecture to undergraduate students, in addition to addressing the industry day and interacting with growers and researchers.

#### Progress with almond breeding project

Considerable progress has been made on the almond breeding program since its inception three years ago. Margaret Sedgley manages the overall project, with collaboration from Chris Bennett of the Australian Almond Growers Association and Barry Tugwell of SARDI.

#### Hybridisation program

Three years of hybridisations have now been conducted, and the work is directed by Andrew Granger. Year 1 and year 2 progeny have been planted at Lindsay Point on the property of Andrew Lacey, and some year 1 progeny produced their first nuts in 1999. In 1999, between 1,000 and 2,000 flowers were used for each hybridisation, involving a number of parents including Nonpareil, Carmel, Mission, Ferragnes, Pearce, McKinlay's, Sommerton, Johnston's, Parkinson's, Price, Peerless, *Prunus webbii*, Lauranne, Ferralise, Ferrastar, Ferraduel, Le Grand, Chellaston, Ne Plus Ultra, Iranian seedlings, and some peach cultivars to breed for self-fertility. Hybridisations were conducted at multiple sites, including the property of Tim Parkinson at Willunga, the Waite and the Loxton Research Centre. For some crosses, self and cross compatibility are evaluated by observations of pollen tube growth. This information is used to plan compatible crosses for future years, and also to provide vital information to growers on compatible pollinators for local selections.

In future years only virus tested trees will be used as breeding parents. In order to achieve this, the netted breeding block at the Waite Campus has been extended and upgraded. It will be planted with virus tested material as this becomes available.

#### Virology

The virology program is run by Evita Alberts, and concentrates on screening for *Prunus* Necrotic Ringspot Virus (PNRSV) and Prune Dwarf Virus (PDV) using antibody-based ELISA. Grafting to the indicator plant *Prunus serrulata* cv Shirofugen is also conducted, as well as testing on susceptible herbaceous plants including cucumber and *Chenopodium quinoa* (a weed related to fat hen), to detect viruses present in almonds. All of the trees in the Monash germplasm collection have now been tested for three consecutive years, to ensure that virus infected budwood is not distributed to the industry. All progeny from crosses made in the program for the first two years, almost 8,000 trees, have been tested for PNRSV and PDV to ensure that virus infected seedlings are not introduced into the evaluation block. Virus infected plants would not perform to their true potential and could provide a source from which

infection could spread throughout the entire block, given the close planting conditions. Testing also ensures that the seedlings do not pose a threat to adjacent commercial plantings. No plants have tested positive to PDV, but a small number have PNRSV.

To further assist the program, antibodies to the almond strain of PNRSV are currently being produced using University of Adelaide antiserum production facilities. This will ensure access to a constant supply rather than reliance on commercially available supplies which can be variable and expensive. For future breeding using clean parents, heat therapy for the elimination of PNRSV from the cultivars Fritz and Suret is currently underway. As yet, there are no data on the optimum time of year to sample for almond viruses under Australian conditions. To address this, a sequential sampling study is underway, using ELISA, woody and herabecous indexing. A block of *Prunus serrulata* cv Shirofugen on F12/1 rootstock has been established at the Waite Campus for woody indexing for the project. This is a useful resource as all graft transmissible agents, including those of unknown etiology, are readily detected by grafting from almonds onto these trees.

### **Genetic fingerprinting**

Work has commenced by Fiona Woolley and Graham Collins to fingerprint the almond cultivars grown in Australia. The method uses DNA patterns to provide a unique fingerprint for each variety. It can be used to confirm identity at any stage of the propagation and cultivation cycle, and also to study parentage and relationships between plants. Of particular interest was the origin of some of the Australian selections. The cultivars investigated fell into two groups, one based on Californian cultivars and the other on European varieties. Australian selections fell into both groups, indicating that some derived from Californian and others from European material. Both groups were quite different from wild almond material collected by Graham Collins in Turkey during the GREMPA meeting.

### **Outcomes from the almond project**

After the first three years of the project, a number of important outcomes have been achieved by the research team.

- Virus tested breeding progeny have been planted for first evaluation in 2000 for new cultivars.
- Detection methods for PNRSV and PDV in almond have been refined.
- The status of the industry budwood source at Monash has been monitored and reported to industry to ensure that virus infected budwood is not distributed.
- Heat therapy is underway on two virus infected varieties.
- PNRSV has been determined to be the most significant virus in almonds so far, with PDV not detected so far.
- Antiserum to an almond isolate of PNRSV is under development to ensure a constant and cost-effective supply.
- Micropropagation methods have been developed.
- Rootstocks of H184 have been generated for use in varietal test blocks to assess the performance of imported material.
- Successful cryopreservation has been achieved.
- Regeneration methods for transformation have been developed.
- Genetic fingerprints are available for the almond cultivars grown in Australia.

Further research is planned in all these areas to advance the Australian industry by improved yields and quality and increased competitiveness on world markets.

