Process of technology transfer at the start of the 21st Century

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Abstract

An understanding of the environmental determinants of strawberry production, as well as production systems used in California and in New Zealand, led to an extensive project to improve fruit productivity in local commercial gardens. The programme started in 1998 and involved developing a proposal for TBG funding; consulting with and visiting Californian researchers and growers; conducting field trials for two seasons (1999-2000 and 2000-01); holding meetings comprising growers, UNITEC staff and, on occasions, visiting Californian researchers; writing articles for grower journals, conferences and scientific journals. Yield increases of over 30% were achieved with a more suitable nursery location and a new cultivar. The rapid increases (up to 20-fold) in nursery plantings of the new cultivar and in the new nursery location occurring since the project started indicates some measure of a successful technology transfer process.

Additional key words: Fragaria x ananassa *Duch., strawberry production, New Zealand, extension, California, chilling*

Background

Links with University of Californian strawberry researchers were first developed by Dr. Greg Pringle during a six-month visit in 1994. During this time he noted that Californian production systems used different techniques and generated vastly superior yields to those in the Auckland region. On his return, he began to formulate ideas about improving the local production system, which had become focused on the cv. Pajaro grown in warm nurseries, by using the key elements of the successful Californian 'winter' planting production system he had observed. This would not have been possible without a thorough understanding of the environmental effects (primarily temperature) on strawberry plant production and some unpublished preliminary evidence on the temperature environment in Auckland fruiting beds (Snelgar *et al*., pers. comm. 1996).

Auckland Region Standard Production System

This system has evolved over many years for the current industry standard cv. Pajaro and involves:

- Sourcing of plants from relatively warm nursery sites around Katikati, these plants having experienced little chilling prior to being lifted.
- Immediate transplanting into the fruiting beds near Auckland.
- High plant densities.
- May planting.
- Cool root environment through the use of black plastic mulch.

This system does little to enhance crown growth over autumn and winter, which is the key to better fruiting potential, and as Auckland soil temperatures are marginal for winter crown growth, planting occurs too late for significant autumn growth and black bed mulch does little to enhance soil temperatures.

The Californian 'winter' planting system

This system involves:

- Sourcing of plants from relatively cold nursery locations, to impart chilling prior to lifting.

- Limited supplemental chilling of the plants after lifting and before planting in the fruiting bed.
- Earlier planting dates in autumn.
- Use of clear bed mulch to warm the root environment.
- Lower plant densities to cater for subsequent plant growth.
- Other cultivars responsive to such treatments.

The system relies on a complete set of production practices to optimise crown growth after planting and through the winter. It is employed in the coastal strawberry production regions of California where climates are not too dissimilar to that of Auckland. There were no apparent practical impediments to the introduction of this production system.

Development of Proposal

A report (Pringle, 1998) detailing strawberry physiology and growth patterns, linking this to the benefits of adopting the Californian 'winter' system to Auckland conditions was initially presented to the strawberry growers. A successful funding proposal was soon developed by a commercial strawberry enterprise (Perrys Berrys Ltd) with industry (New Zealand Berryfruit Propagators, NZBP) and government (Technology New Zealand) support, subcontracting UNITEC for the design and implementation of the R&D. The UNITEC research team combined the strawberry experience and connections of Dr. Pringle with the broad horticultural research experience of Dr. Bussell and the practical horticultural abilities and teaching role of Ms Ennis. The concept of a research team based in an educational institution focussed on applied research and teaching, coupled with strong industry links and an emphasis on new knowledge for economic benefit was seen as a good fit. It seemed an excellent way to be contributing to the development of our knowledge economy as both growers and UNITEC students would benefit directly.

Academic-Industry Collaboration

1. First-hand knowledge of the Californian production systems was instrumental for the success of the project. Two of UNITEC's research team travelled to California in mid-1999 to see the entire commercial process, from nursery sites in northern California to fruit production beds near Los Angeles. A reciprocal visit by Californian researchers during Auckland's fruiting season in late 1999 enabled them to comment on plant form and minor husbandry practices necessary for the fine-tuning of the production system, as well as the data emanating from the project. Their experience with the new cultivar (Camarosa) helped in our assessment of the growth and yield achieved from this cultivar in our environment compared to theirs. Both visits consisted of researchers liasing with local commercial nursery and fruit-growers, thus identifying best practice, via site visits and evening workshops.

Conduct and Results of Field Trials

More detailed accounts of the conduct and results of field trials have been published elsewhere (Ennis *et al.*, 2001, Pringle *et al.*, 2001). Experimental and commercial scale trials were located at a commercial strawberry garden at Mangere, Auckland. Cultural practices related to bed preparation and planting, fertiliser application, irrigation, and pest and disease control were the same as for the entire commercial garden. The trials were conducted over two fruiting seasons (1999-2000 and 2000-01) and a full factorial of cultivar (Pajaro and Camarosa), nursery (Katikati and Ohakune), planting time (during April and May) and mulch (black and clear) in split-plot or randomized complete block designs with four replicates was planted. Temperatures at 10cm soil depth, within the plant canopy at 10cm above the plastic, and at 1.5m screen height were measured to the nearest 0.1°C at 10-minute intervals from planting to the end of the first fruiting season using datalogger probes set within plots of cv. Camarosa. Long-term meteorological records from nearby Auckland International Airport were obtained to place the 1999 season in climatic context. Fruit was harvested for about 16 weeks in each season. Harvest practices and grading standards mirrored those of commercial operators.

Important results were:

- Cv. Camarosa produced approximately twice the yield per plant of cv. Pajaro. Fruit was less damaged by rain, fruit size did not decrease so greatly during the season and fruiting bed plants had fewer runners.

- Cv. Pajaro plants sourced from the cold nursery (Ohakune) yielded 27% more than those from the standard, warm nursery (Katikati) over both years. Cv. Camarosa plants sourced from Ohakune averaged an 11% higher yield over the two seasons. Higher yields from Ohakune plants were obtained mostly in the early and middle part of the season.
- Ohakune sourced plants established more successfully in the fruiting beds than Katikati sourced plants and grew more rapidly after planting.
- Bed soil temperatures up to 1.5°C higher under clear mulch gave greater winter plant growth and higher yields than those grown under black mulch. However, weeds (mostly clover) grew so extensively under clear mulch that its use to warm the beds in winter is impractical for commercial operations.
- Earlier planting dates gave the best yields in cv. Camarosa in both seasons but not for cv Pajaro These higher yields were obtained mostly in the early part of the season.
- Results from commercial scale trials were generally within 6% of those from experimental trials.
- Seasonal differences were large, with yields consistently 20% lower in 2000 compared with 1999.

Conveying Results

We have conveyed our results as presentations, newsletters, grower journal papers, reports and refereed conference papers. A chronological summary of our extension activities is provided in table 1.

Spin-offs For Future Research Opportunities

The results obtained over the last two seasons reveal opportunities for further improvement in strawberry plant productivity and economic outcomes. These include investigation of:

- Colder sites within the Ohakune region.
- Plant damage and economics of mechanised runner harvest.
- Opportunities to increase runner crown size spectrum through new management regimes for elite and runner beds.
- New Infra Red Transmissible (IRT) mulch types for soil warming without the associated weed problem.
- Optimising cultural practices for other cultivars.
- Evaluating cultivars of other Californian breeding programmes.

Table 1. Extension activities.

		Primary Audience	
Date	Activity Type	Industry Sponsors	Academia
June 1999	Report	NZBP	
December 1999	Presentation	Auckland Berryfruit Growers Assoc. Katikati nursery growers	NZIAS/NZSHS Auckland section
March 2000	Newsletter	Strawberry Growers NZ	
March 2000	Report	NZBP	
April 2000	Presentation		UNITEC staff and students
June 2000	Presentation	National strawberry industry research day	
			NZIAS/NZSHS Auckland section
July 2000	Presentations		International Strawberry Symposium (Finland)
August 2000	Presentation		UNITEC staff and students
December 2000	Field Day	Waikato strawberry growers	
March 2001	Newsletter	Strawberry Growers NZ	
March 2000	Report	NZBP	
April 2001	Journal Article	In *NZ Commercial Grower*	
June 2001	Presentation	National strawberry industry research day	
June 2001	Report	Strawberry Growers NZ members	

- Optimising nutrient requirements for new cultivars e.g., Camarosa and Gaviota.
- Strawberry physiology: discovering the critical temperature range and time period for optimal accumulation of chilling.

Further research has not continued in the current funding environment. The short term funding of this and other projects has implications in terms of disjointed research and loss of researchers available for the strawberry industry in the future. Since the team now has a considerable skill base and enthusiasm, further funding bids in the area of strawberry production are inevitable.

Impact on the Industry

The industry has moved in the direction of the recommendations we have put forward in our technology transfer exercises of the past two years. Ohakune plantings have risen from 100 000 plants in 1999 to nearly 2 million plants in 2001. Plantings of cv. Camarosa have increased from 299 070 in 1998 to approximately 2 million in 2001. While we cannot claim full credit, we feel partly responsible for this significant shift in grower practice giving improved production potential. The following features of our project may have given growers the confidence to test this new production system themselves:

- Robustness of data
- Close alignment of experimental yields with commercial yields
- Proactive and frequent dialogue with industry
- Strong economic benefit

Acknowledgements

Technology New Zealand, New Zealand Berryfruit Propagators Ltd. and Perrys Berrys Ltd financially supported this work. We thank Professor Douglas Shaw and Dr. Kirk Larson (University of California Davis), Mr. Pete Pattinson (NIWA), and Dr. Chris Triggs (University of Auckland) for advice and expert assistance. We also thank staff of Perrys Berrys Ltd and several past and present UNITEC horticulture students for help during planting, growth analysis and fruit harvesting. Bruce Rapley and Michael Shanley were generous suppliers of plants from their Ohakune nurseries.

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