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Crop management service development for seed potato production in Tasmania

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Purpose of the report To summarise the activities and outcomes of the Seed Management Service (SMS), a technology transfer project conducted over three years (2002 – 2005) in Tasmania.

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Media Summary

French fry potato processing provides much needed value adding and employment opportunities in regional Australia. The Australian French fry potato industry supplies about 600kt, worth about $140m at the farm gate to four factories for processing. About 400kt are supplied in Tasmania.

SMS is a crop management program which was developed to assisted seed growers to adopt new technologies to address tightening profit margins, the spread of plant diseases and rising community expectations for the environment. SMS is an exciting concept in two important areas:
1. It provides growers with ownership and control of the process to find, assess and adopt new technology.
2. It forges closer links between growers and processor. This is important for the understanding of shared challenges.

The development and management of SMS has been driven by a steering committee, with grower and processor members. Grower support is strong, and major crop management changes have been evident. SMS was funded through a Voluntary Contribution project between Simplot and its seed potato growers, and HAL.

The service has been scrutinised by the stakeholders to ensure that it maintains value for money and provided strong benefits. Key outcomes included:

- Improved consistency of seed quality, with reduced rejection.
- More efficient production from better use of pesticides, fertiliser and water.
- More reliable supply of seed potatoes.

The input of Agronomist, Chris Russell, and the Seed Manager, Robert Graham, has been vital to the success of the service. Similar services must include the services of outstanding staff with agronomy skills.

Seed growers in Tasmania now routinely use better technologies, such as plant nutrient analysis and electronic soil moisture probes. SMS has maintained a research and development component to seek improved technology. New areas for future work in the Tasmanian potato seed industry have been identified by SMS; including, improved planter accuracy and better plant nutrition strategies to increase yield and reduce disease.

SMS has accelerated the process of change and has shown worthwhile benefits to all stakeholders.

Introduction

Processed potatoes are freely traded, without the quarantine and shelf life issues of fresh tubers. Processors in Australian must be competitive to maintain and grow market share, and to develop emerging export opportunities in Asia. Access to high quality, efficiently produced seed forms the base of a strong production system. The crop management service (SMS) was developed to promote and enable the rapid adoption of new technologies by the seed potato industry in Tasmania.

The cost of poor seed, whether caused by poor irrigation, nutrition or pest and disease management, has a strong effect on the processing grower as well as the processor, undermining the viability of the whole industry. In the years leading up to the launch of SMS, around 50% of the planted seed potato crop has been rejected for certification. Many processing potato growers had also expressed dissatisfaction with the apparent vigour and physiological age of the seed tubers produced for commercial crops. Improved approaches to crop management decisions will reduce the chances of crop rejection and improve the productivity of processing crops grown from better seed.

Significant advances have been made recently in the technologies for irrigation scheduling, plant nutrition strategies and integrated pest and disease management.

These new technologies rely heavily on the supply of timely information about the crop. The information will also provide the industry with a databank to be used as a research tool. Prior to 2002 the majority of seed potato growers in Tasmania did not use soil moisture monitoring equipment, plant nutrient analysis or crop scouts to regularly assess pest and disease populations in their crops. Without this important information, crop management can be well below best practice.

The main aim of the project was to provide a mechanism for the widespread adoption of the new technology. The planned outcomes were:

- Reduce seed crop rejection for certification from 50% to less than 30%.
- Improve the productivity of commercial processing potato crops in Tasmania by 3t/ha (51t/ha vs 48t/ha).
- Improve field production efficiency for potato seed and reduce environmental impact through better (more timely) use of inputs such as chemicals, fertiliser and water.
- Improved factory efficiency through increased quality of processing crops grown from better seed.

This project was designed to provide a crop management service, based on new technologies, to seed potato growers in Tasmania. It used, and built on new experience and information from VG01078, a recent HAL project for sweet corn growers. The service was based on Simplot Staff (Agronomist, Seed Manager and Field Officers) as well as seasonal staff to provide irrigation scheduling, plant nutrition and pest and disease modules.

Technology transfer strategy and methodology/activities

The development of SMS was based on the provision of an integrated crop management service for seed potato growers in Tasmania. SMS differs from the range of existing services available to the growers, in that it is a complete crop management service that is tailored to the specific needs of seed potato production for each individual grower.

SMS has a modular structure. Four core modules have been identified in discussion with experienced growers and Simplot Staff:

- Plant Nutrition Strategy
- Pest and Disease Management
- Irrigation Scheduling
- Pre-plant Planning

These core modules have a synergistic effect when applied together in the field, and are presented as the basic package. Efficiencies in service delivery also result when these modules are supplied as one package.

The details of the core modules are:

(I) Plant Nutrition

- Pre-plant soil analysis – at least P, K, N, Cu, Zn, Mn, Fe, pH, salinity, organic carbon.
- Soil analysis report, interpretation and advice.
- Pre-plant discussion between grower and agronomist to plan the fertiliser strategy.
- A minimum of 5 plant tissue samples per crop for macro and micro element analysis.
- Plant tissue and soil analysis reports, interpretation and advice.
- End of year summary of plant nutrition, with notes for future fertiliser programs.

(II) Crop monitoring

- Pre-plant discussion of paddock history to assist with planning weed, pest and disease control.
- Weekly inspection for crop health, pests, diseases and weeds.
- Detailed monitoring report produced 'on the spot'.
- Professional plant pathology and entomology back-up when needed.
- End of year summary, including reports on yield, quality, weed, pest and disease levels, comparisons with district averages, and notes on implications for future crop management programs.

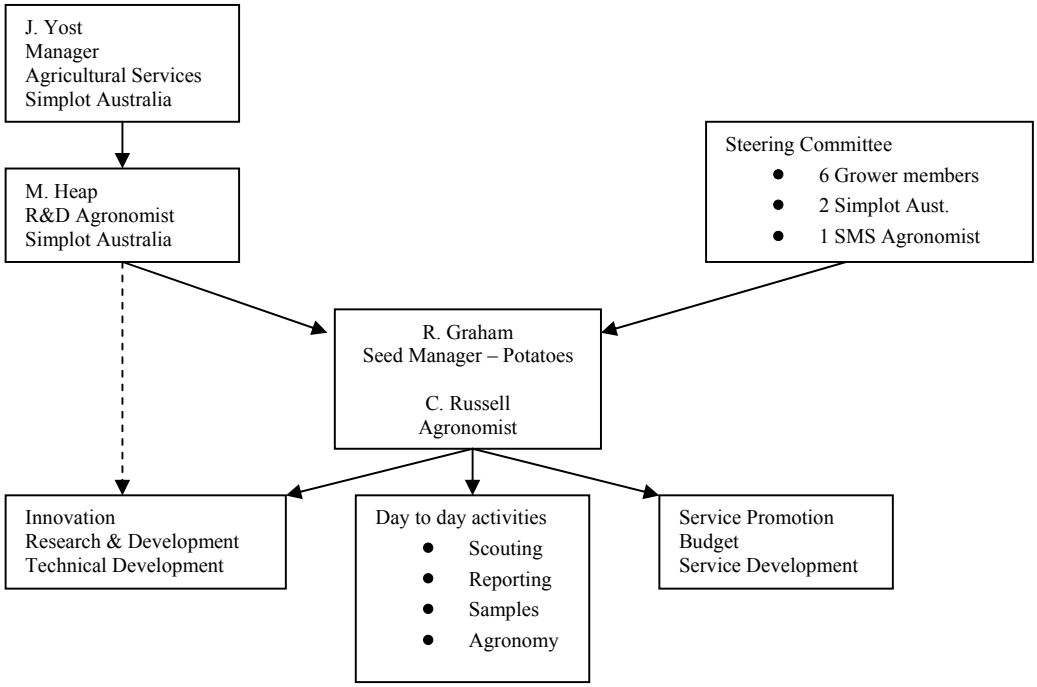
(III) Irrigation scheduling

- Pre-plant discussion to assist with the general approach for crop irrigation and to examine the capability of the irrigation plant.
- Installation of electronic soil moisture probes. Capacitance technology with data logging. These were replaced by logging devices using granular matrix sensors but with LCD screens for in-field historical moisture viewing.
- Regular visits to discuss soil moisture results.
- End of year summary of irrigation operations, including graphs showing the amount and timing of water applied, seasonal soil moisture levels, and notes on implications for future irrigation management.

(IV) Pre-plant planning

A formal discussion session between the grower and agronomist is used to develop an overall strategy for key crop management operations. The output is simple, practical, and presents the details and timing of the key crop management operations on one page.

The structure of SMS was set up to ensure that the seed potato growers (clients) had a strong voice and a role in the technical and business development of the service. The steering committee was an outstanding success in this role. The diagram below shows the structure for 2002 – 2005.



SMS used the staff and infrastructure of Simplot Australia:

Staff	Office/Location	Major Equipment	Notes
Agronomist	Devonport*	Car/mobile phone/computer	20% 2002-2005
Seed Manager	Ulverstone Field Office	Car/mobile phone/computer	10% of time
Field Officer	Ulverstone Field Office	Car/mobile phone/computer	20% time
Scout	Ulverstone Field Office	Car/mobile phone	Casual/seasonal
R&D Agronomist	Simplot Kensington	Car/mobile phone/computer	10% of time

* Simplot field office with computer, fax, photocopier etc.

The ongoing identification, development and adoption of new technology are the life-blood of SMS. Service development has been the day-to-day responsibility of the Agronomist, with assistance from the R&D Agronomist. The Steering Committee has overseen the general direction of service development, setting priorities for the future. The Steering Committee held 2-3 meetings a year, and performed well as the voice of industry.

Technology transfer was the constant focus of SMS. In addition to regular constant (weekly) with growers, the Simplot Staff have conducted several workshops for growers in each year to discuss SMS technology and data. All growers received detailed reports for each crop, in each year. One-on-one meetings were held annually with an agronomist to discuss the implications of the crop report.

The Steering Committee and Agronomists have initiated research to develop new technology for local issues. This has included several field demonstrations of common scab disease management strategies.

Some significant technical insights came from the analysis of the collective SMS database. These include:

- A large effect of seed crop planting date on the rejection rate for certification. Later planted crops (Nov-Dec) had dramatically lower rates of rejection than the previous common practice (October planting).
- Rates of applied fertiliser were not well correlated with nutrient levels in tissue analysis and poorly correlated with yield.
- Heavy rates of fertiliser were more likely to result in tuber defects, such as increased hollow heart.
- Soil trace element status was related to disease incidence in vines and tubers.

Evaluation and measurement of outcomes - impact and adoption

Trends in tuber yield for seed potatoes and subsequent processing crops are difficult to demonstrate over a short number of years. Tuber yield is affected by a great number of factors, of which the variation in seasonal conditions between years is often the strongest. Despite this the signs are encouraging. Table 1 shows the mean tuber yield for seed potato crops over the three years of the project. A quick glance finds that the total and seed yield of tubers has not risen, with a flat or slightly declining trend. However this must be put into perspective by the sharp reduction in the number of growing days for seed crops throughout the project, driven by the need to improve seed quality and lower rejection rates.
Later planting dates and earlier harvest dates led to the fall in growing days from 140 in 2002/03 to 120 in 2004/05. Alone this would have been expected to reduce tuber yield for seed crops by around 15%.

Average for Season	**Seed Yield (t/ha)**	**Total Yield (t/ha)**	**Oversize (t/ha)**	**Growing Days**	Rejection (%) 3 year rolling mean
Pre-SMS				140+	52
2002-3	51.7	57.8	12.0	140.2	46
2003-4	52.5	60.5	6.5	130.3	37
2004-5	47.4	57.5	4.7	120.0	27

Table 1. Seed potato yield, growing days and rejection rates for Simplot seed growers.

Table 2 shows the average yield of processing tubers grown from Tasmanian seed crops. A three year rolling average has been used in an attempt to reduce the annual effect of seasonal variations.

		Processing yield t/ha (ex 300kt) 3 year rolling mean
Pre-SMS	2000-01	
Pre-SMS	2001-02	
Year 1	2002-03	46.1
Year 2	2003-04	47.8
Year 3	2004-05	48.3

Table 2. Processing potato yield (3 year rolling mean) grown from Tasmanian seed tubers.

Discussion

Soil moisture and yield were related, and irrigation scheduling was the strongest influence on crop performance. Centre pivots, linear move, and solid set irrigation systems were superior for matching irrigation applications to crop requirements than the commonly used travelling gun. The successful management of irrigation scheduling relies on a good understanding of crop stage / crop factor, soil characteristics, irrigation system capacity, and forward projections of weather conditions. The SMS data has shown the importance of monitoring soil moisture, especially below 30cm, and there is a trend for the depletion of deep soil moisture reserves, particularly for centre pivots, linear move, and solid set irrigation systems. It was commonly observed that traditional irrigation strategies were able to maintain surface soil moisture, often with little or no visual indication of water stress - until a low yield at harvest.

The use of "farmer-friendly" soil moisture monitoring technology has improved grower understanding of soil moisture use by seed potato crops, maximising yield potential and reducing potential quality issues with excess or deficient soil moisture. The monitoring equipment used was sourced from the United States and introduced to Tasmanian seed potato growers involved with SMS.

Fertiliser application to seed potato crops has been a major focus of SMS. The pooled data for plant tissue levels and applied nitrogen indicates that excessive nitrogen application is common and does not increase seed yield or quality.

The project made a strong impact on the attitude of the seed potato growers of Tasmania. The value of the closer working relationship was high, as the processor and the growers worked through a rationalisation of the industry. Over this period the number of SAPL seed growers has been reduced from 85 to 28. The influence of SMS on grower attitudes is still evident. As a group, the growers are more active than in the past at pursuing new technology. Several growers now own and operate electronic soil moisture monitoring equipment, and the routine use of soil tests and plant tissue analysis is now widespread.

Growers have embraced the analysis of SMS data from all of the crops combined as a research tool. Several grower initiated ideas and demonstrations have emerged from this approach.

Many myths about seed potato production were dispelled by providing growers with information on their own performance compared with the district and industry averages (eg. irrigation timing and quantity). Some of the myths relate to high rates of pre-plant and planting nitrogen and also the maintenance of low soil moisture during early plant growth.

Table – Estimate of the financial impact of SMS

Item	Beneficiary	Source of benefit	Annual value
Reduced rejection for certification	Seed Grower	Rejection reduced from 52% to 27%. Seed value $330/T vs $220/T processing tubers	$495k
Increased yield of processing tubers.	Processing Growers	Yield increase 2.2 T/ha x 6,000ha at nett value (after harvest & freight) $160/T.	$2.1m
More efficient use of pesticides, fertilisers and water to produce seed crops.	Seed Grower, Environment	Reduced incidence of unnecessary or insurance applications.	?
Annual Total			$2.6m

Although the magnitude and actual source of the benefit has changed from the original proposal, it has shown a very good return on the investment of R&D funds:

The benefit arising from this project has been estimated for the French fry processing potato industry in Tasmania for a ten-year period. The value does not include the research and development advances that will accrue from the systematic collection of crop data.

Research & Development Benefit	**$ 26m**
Discounted R&D Benefit (8%)	**$ 16.6m**
Cost of Work HAL funds	**$ 0.254m**
Total (including "proposing organization and other")	**$ 0.497m**
Ratio of Discounted Benefit : Cost (HAL funds)	**65 : 1**
Ratio of Discounted Benefit : Cost (Total)	**33 : 1**

This return does not take into account the intangible benefits such as smaller environmental footprint, reliable supply, and a better relationship between processor, grower and researchers.

Recommendations

The analysis of SMS databases revealed several areas of potential future research:

- The relationship between certain potato diseases and soil reserves of zinc and copper.
- The relationship between long term paddock history and the incidence of disease.
- Soil preparation, soil structure and compaction and its influence on disease and yield.
- Refined fertiliser strategies to increase yield and reduce disease pressure.

The value of keeping and combining crop data for multi-variate analysis has been exceptional. Groups of seed growers should be encouraged to continue with this research approach to solving or understanding their problems.

Acknowledgments

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Well done to Chris Russell and Robert Graham, who performed at an exceptional level and put in the extra miles needed.

Thanks to Horticulture Australia and Simplot Australia, who invested significant resources (people and money) into the future of the industry in their support of SMS.

Bibliography

Primary Industries South Australia. 1996. Potato Crop Management Service – Operating Manual.