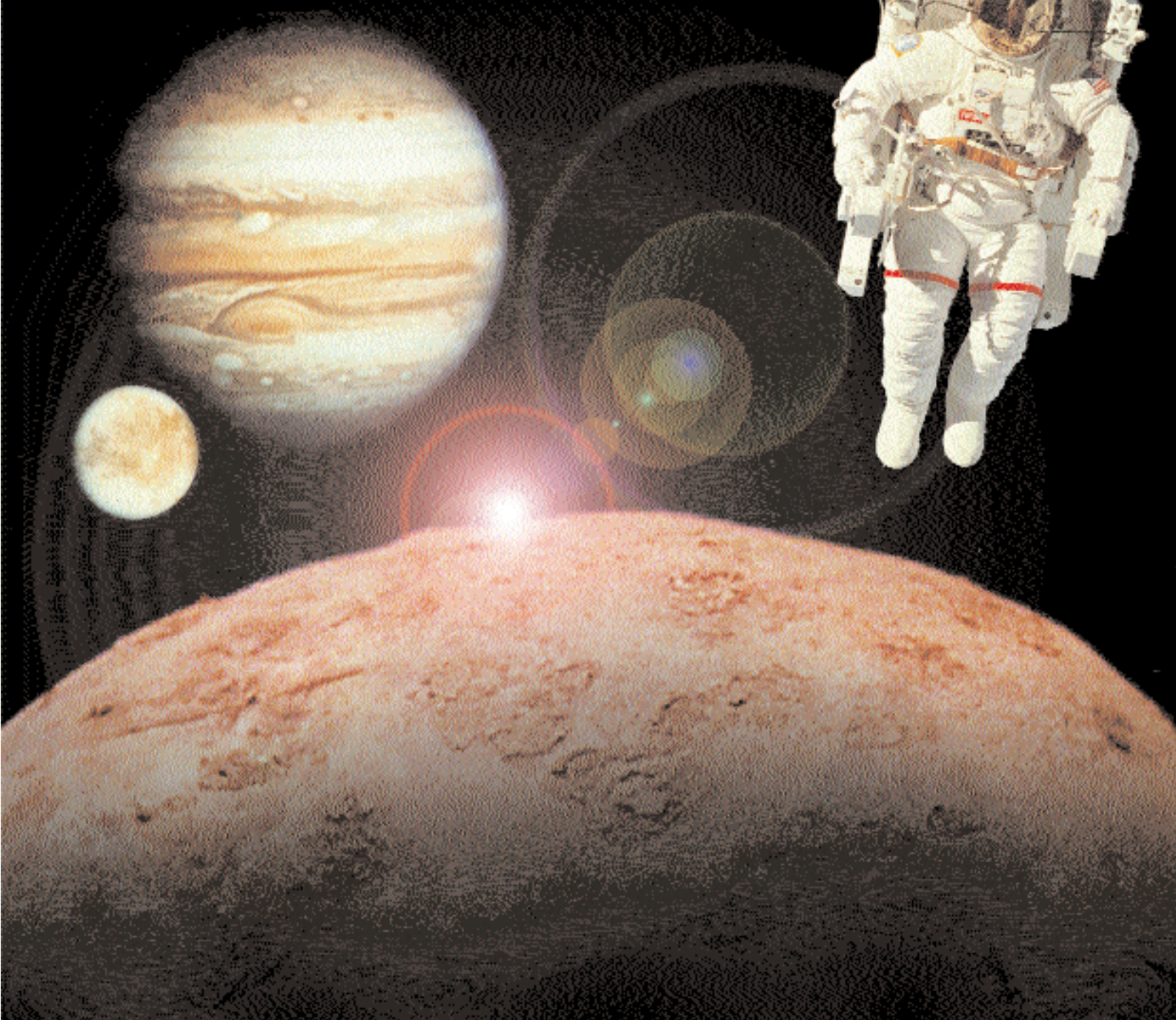
Potato Australia

PUBLISHED BY THE AUSTRALIAN POTATO INDUSTRY COUNCIL

VOLUME 10 SEPTEMBER 1999 ISSN 1036 – 8558

Spuds in Space?



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Editorial

Welcome to the 1999 edition of *Potato Australia*. You may be wondering about the relevance of the front cover but as we move into the new millenium, it is important to think about the broader possibilities of what can be achieved. So often we are constrained by what we are used to and yet we see examples all the time of how a bit of innovative thinking can open up new opportunities.

Potatoes in space is not so off beat as you may imagine. As part of their space program, NASA has managed to initiate tubers in space (see page 6), indicating that there is some potential for potatoes to be a food source for future space stations. We are not promoting a space potato industry at this stage but who knows what the future may hold.

Coming back to Earth, the article on irrigating with saline water on page 34 raises what may prove to be a crucial management issue for some production areas and may cause some to rethink their irrigation strategies.

The results of a review of *Potato Australia* and *Eyes on Potatoes* (page 64) are very pleasing and provide us with the knowledge that we are on the right track. That is not to say we will rest on our laurels. There are still improvements we want to make and we will always be looking for ways to make these publications more valued by our readership.

There is one trend that is very obvious and that is the need to manage information. As we enter the information age the ability to capitalise on opportunities will depend on the potato grower's ability to be able to source the information they need and turn that knowledge into a benefit.

Publications like *Potato Australia* will continue to play an important role but other media such as the internet will become increasingly important.

New ways of obtaining and managing information will play a crucial role in the advancement of the industry. The benefits of these changes may not always be obvious at first but as time goes on these concerns will be allayed as the new technologies become a normal part of the way we do business. The challenge for everyone is to keep an open mind as to the possibilities.

So as we enter the new millennium, welcome to the information age. It is an exciting world we live in!

Nathalie Jarosz - Editor

Leigh Walters - Assistant Editor

WARNING: ANY MENTION OF PRODUCTS DOES NOT IMPLY ENDORSEMENT NOR INFER REGISTRATION. CONTACT YOUR LOCAL DEPARTMENT OF AGRICULTURE OFFICE FOR ADVICE ON REGISTRATION STATUS.

Contents

ACKNOWLEDGEMENT

Designed and printed by sprinta PRINT

We thank the Horticultural Research Development Corporation (HRDC) for its financial contribution towards the production and distribution of Potato Australia.

Chairman's message

IAN RICKUSS
Chairman
Australian Potato Industry Council
(07) 5465 8247

The year 2000 is fast approaching and hopefully the new century will be good to all those working in the potato industry.

Our Strategic Plan has been published after a lot of consultation with industry. This will hopefully, in conjunction with the R&D Plan and Communication Plan, give the industry some real direction for the future, particularly with our R&D program.

A survey has been conducted of *Potato Australia* and *Eyes on Potatoes* with some very pleasing results. These publications are the main form of communication between many growers and researchers and it is important that they meet the industry's needs. A lot of credit must go to the efforts of the contributors and Nathalie Jarosz's editorial and production team, as without them we would not have such good publications.

On the R&D front the review into NaPIES has proved to be a 'tougher nut to crack' than we first thought. More work still needs to be done and the R&D Committee will re-look at the situation at the October R&D Committee meeting.

We have also had a changeover of some of the R&D Committee members. As mentioned in *Eyes on Potatoes* Lawrie Shaw retired from the R&D Committee in March. He has now been replaced by Frank Rovers a crisping grower from Cora Lynn in Victoria.

Our two processing representatives have also changed. Jeff Peterson from Smiths and Peter Hardman from Simplot have retired and been replaced with Tony Gietzel from Snack Brands Australia and Paul Frost from Saffries. I would like to thank both Jeff and Peter for their contributions. Their input has been very much appreciated. To all our new members, welcome.

Eric Coleman's project on marketing and QA is in its final stages and he has produced some very interesting results. The work should help industry resolve many of the questions about QA.

Nathalie Jarosz, Barry Philp and Leigh Walters have been working on what the industry needs in Electronic Information Services, and in particular, an internet site. For most of us, this is a hard area to get our minds around and yet it offers so many possibilities for the industry.

I would like to thank Max Walker for his work in the potato industry over the years. Max retired as Secretary of APIC in May. Brian Newman (AUSVEG) will be acting as Secretary of APIC until the Annual Meeting in November.

Best of luck for the New Year. ■

Potato Australia is produced by the Department of Primary Industries, Water and Environment, Tasmania, on behalf of the Australian Potato Industry Council.

Potato Australia
PUBLISHED BY THE AUSTRALIAN POTATO INDUSTRY COUNCIL

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PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

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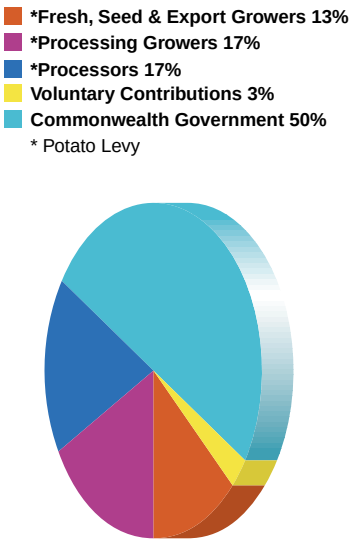
Your levy at work

Money collected through the Potato Levy is used to fund research and development important in helping the potato industry meet market needs and remain profitable in a rapidly changing world.

Potato Australia now reports on all the potato projects funded through HRDC.

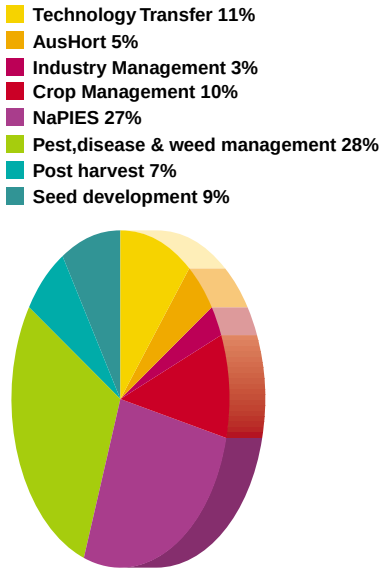
The table HRDC Potato R&D Projects for 1999-2000 (p 8) lists all projects whether they are commencing this year (p 18), finishing this year or still in progress. For those projects finishing or still in progress there is either a full article or a progress report (p 11).

Source of funds for projects



Total Funds available $2,010,656

How is the money is spent



Spuds - first food grown in space

The first food grown in space - five stem cuttings each initiated a tuber during a space mission

The humble spud has become the first food to be grown in space.

In a 1995 space mission, scientists managed to grow tubers from leaf cuttings, using a specially designed growth chamber called ASTROCULTURE™. This experiment was aimed at learning to grow food in space to support future space stations.

Five potato leaf cuttings (variety *Norland*), each with a small portion of stem attached were placed in the ASTROCULTURE™ growth chamber which provided the desired environmental conditions for potatoes to grow.

On return to Earth it was found that each cutting had produced one tuber of about 15mm diameter. The outward appearance of the tubers did not appear to be significantly different from Earth-grown tubers. These results provided an initial indication that potatoes may indeed be a good crop for a long-term extraterrestrial food supply.

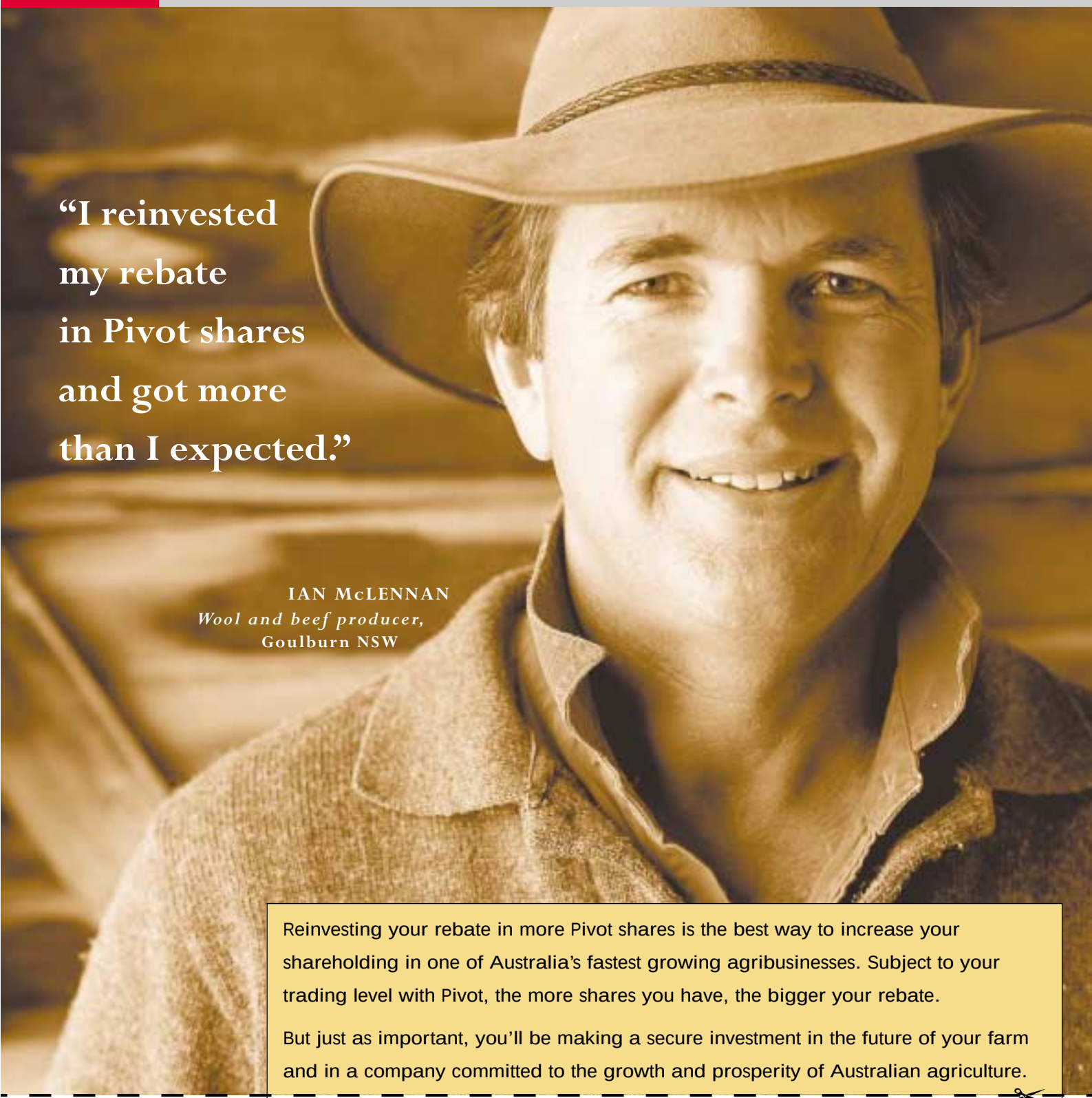
The benefits of plants in space go beyond providing a food source. They also help remove excess carbon dioxide, replenish oxygen, purify water and give a psychological lift to astronauts.

The experiment was conducted by the Wisconsin Center for Space Automation & Robotics (WCSAR) at University of Wisconsin, a Commercial Space Center (CSC) under NASA Space Product Development (SPD) Office. ■

Inside the ASTROCULTURE™ growth Chamber

This article has been prepared from information provided by Dr Weijia Zhou, Director, Wisconsin Center for Space Automation & Robotics (WCSAR), and from Perspective Volume 22: Winter 1995-96 University of Wisconsin-Madison College of Engineering .

(For more information look at the following website http://rouge.engr.wisc.edu/alumni/perspective/22.2/spuds.html)



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HRDC Potato R&D Projects for 1999-2000

Project title	Chief investigator		Page
Crop management			
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Determination of the biochemical and genetic factors affecting cadmium accumulation in potato tubers	Dr Christopher Davies, CSIRO Plant Industry	08 8303 8629	18
Developing soil and water management systems for potato production on sandy soils in Australia	Robert Peake, Primary Industries and Resources South Australia	08 8724 2913	39
Effect of calcium nutrition on decay of summer sown seed potatoes	Dr Greg Howell, NSW Agriculture	02 6951 2510	54
Mechanisms of cadmium accumulation by potato tubers	Dr Mike McLaughlin, CSIRO Land and Water	08 8303 8433	11
More economic and environmentally responsible use of phosphorus fertiliser in potato cropping on krasnozem soils in Australia	Dr Leigh Sparrow, Tasmanian Institute of Agricultural Research	03 6336 5379	41
Potato tuber quality management in relation to environmental and nutritional stress	Stephen Harper, Queensland Horticultural Institute	07 5466 2222	18
Remote sensing as an aid to horticultural crop recording and husbandry	Dr Rowland Laurence, Tasmanian Institute of Agricultural Research	03 6430 4901	11
Sustainable potato production in highland NSW - Stage III	Sandra Lanz, Lanz Agricultural Consulting	02 4677 0198	36
Sustainable use of reclaimed effluent water for horti-cultural irrigation on the Northern Adelaide Plains, SA	Dr Daryl Stevens, University of Adelaide	08 8303 6700	11
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Breeding crisp potato varieties - Stage 2	Dr Roger Kirkham, Agriculture Victoria	03 5962 9218	28
Breeding French fry potato varieties - Stage 2	Dr Roger Kirkham, Agriculture Victoria	03 5962 9218	28
Breeding fresh market potato varieties - Stage 2	Dr Roger Kirkham, Agriculture Victoria	03 5962 9218	28
Evaluation and development of new potato genotypes - South Australia	Dr Chris Williams, SA Research and Development Institute	08 8389 8808	28
Potato breeding & cultivar evaluation - WA	Peter Dawson, Agriculture WA	08 9892 8461	28
Potato cultivar accession and testing in Tasmania	Dr Rowland Laurence, Tas Inst Ag Research	03 6430 4901	28
Potato cultivar evaluation in Victoria and NSW	Dr Roger Kirkham, Agriculture Victoria	03 5962 9218	28
Selection and evaluation of potato cultivars in Qld	Dr Ken Jackson, Queensland Horticultural Institute	07 5466 2288	28
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Characterisation of Australian isolates of Phytophthora infestans and planning to manage new and more aggressive strains of the fungus	Dr Andre Drenth, University of Queensland	02 6272 4878	12
Cleaning and disinfection practices for potato farms	Dr Dolf de Boer, Agriculture Victoria	03 9210 9222	56
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Development of extreme resistance (immunity) to common scab disease within current commercial potato cultivars	Dr Calum Wilson, Tasmanian Institute for Agricultural Research	03 6226 2638	13
Enhanced biodegradation of soil-applied pesticides - determination, risk assessment and prevention strategies	John Matthiessen, CSIRO Entomology	08 9333 6641	13
Influence of rotation and biofumigation on soil borne diseases of potatoes	Dr Dolf de Boer, Agriculture Victoria	03 9210 9222	13
Investigation on common scab disease of potatoes and development of control methods	Dr Hoong Pung, Serve-Ag Research	03 6427 0800	14
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New chemical treatments for fungal diseases of seed potatoes	Dr Dolf de Boer, Agriculture Victoria	03 9210 9222	14
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Project title	Chief investigator		Page
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AusHort (Projects funded by all horticultural levy paying industries)			
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■ - New projects that have been approved and will commence once contracts have been finalised or have commenced this year.

■ - Projects ending in 1999

VC only – Voluntary contribution only, no Potato Levy money used.
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R&D projects in progress

Over the next few pages we present a brief summary of all levy funded projects currently in progress, other than those that are reported on in full elsewhere in this publication.

If you want more information on any of the projects, please contact the researcher on the phone number or email provided.

Projects with a PT are totally or mainly funded from the potato levy. Those with a VG are mainly funded from the vegetable levy with some funding from the potato levy. Those with a HG are funded from a number of industries with some funding from the potato levy.

Crop management

Mechanisms of cadmium accumulation by potato tubers

(PT - Project started July 1997)

This project aims to determine the pathways of cadmium accumulation in potato tubers. We know that cadmium is fairly mobile in the plant and development of strategies to minimise accumulation in tubers requires knowledge of the processes involved.

Experimental work over the last 12 months has focused on identifying the pathways by which cadmium enters the potato tuber. Cadmium could enter tubers either directly through the skin, through the roots associated with the tuber and stolons, or through the stolons during tuber filling by transfer of cadmium from the leaves of the plant (in the plant phloem).

Seed tubers of *Kennebec* were grown in an experiment using radioactively labelled cadmium to investigate the role of the different types of roots in supplying cadmium to the tuber. Approximately 80-85% of the cadmium in the tuber was found to come from the basal roots, and not through the tuber skin or tuber and stolon roots. This suggests that the majority of cadmium in the tuber is taken up into the plant to the leaves and then transported back to the tubers.

This means that cultivar differences in cadmium concentrations in tubers may be related to the ability to retain cadmium in the leaves, and that this mechanism should be manipulated and used to reduce tuber cadmium concentrations in breeding programs.

MIKE MCLAUGHLIN and KELLY DUNBAR
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Remote sensing as an aid to horticultural crop recording and husbandry

(VG - Project started August 1997)

This project aims to determine if satellite imagery can distinguish between individual horticultural crops. Crop recognition in this way may lead to cost effective ways of monitoring growth and yield and improving the integration of crop management tasks. It would also provide the basis for a simple and cost effective paddock inventory system.

The 1998-99 cropping season is the second of two seasons in which this project has acquired a sequence of satellite images taken over the season. These are being used to attempt to recognise a wide range of crops at two Tasmanian locations (Coal River Valley and the North West Coast).

A first attempt to recognise a range of unknown crops present in paddocks has resulted in success rates ranging from 54% for peas to 100% for oats. Potatoes scored a success rate of 74%.

These levels are encouraging as the data used has yet to be refined by relating the images used to exact crop planting and harvest dates.

Images from two satellites, Landsat and Spot, are being used in the project. The availability of the new Spot 4 satellite in the 1998-99 season's work should provide improved recognition and the capability to identify paddock boundaries directly from images.

The project is funded by HRDC and Botanical Resources Australia and is undertaken in collaboration with the University of Tasmania, Serve-Ag and the Department of Primary Industries, Water and Environment, Tasmania.

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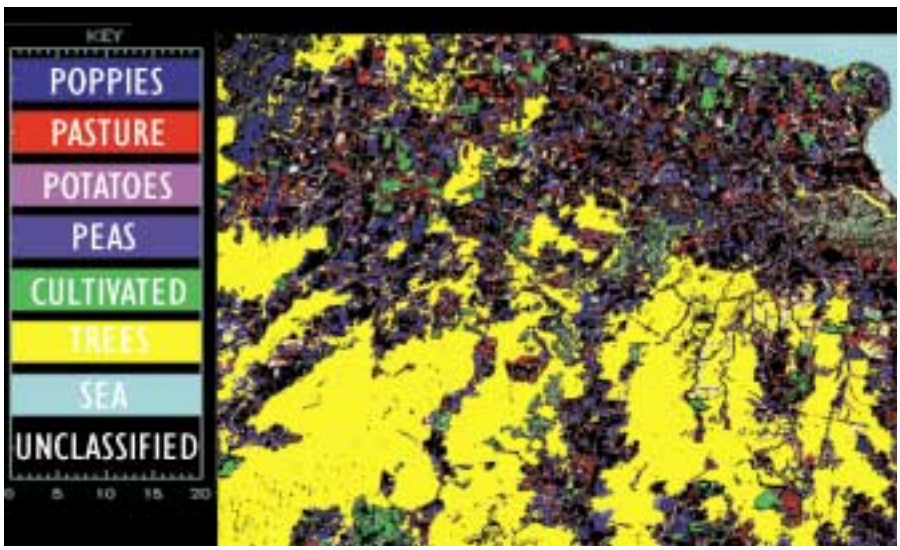
Sustainable use of reclaimed effluent water for horticultural irrigation on the Northern Adelaide Plains

(VG - Project started January 1998)

This project aims to determine the impact of using class A reclaimed water in vegetable crops, including potatoes. The recycled water, soon to be supplied to growers, will contain significantly higher concentrations of boron, nitrogen and phosphorus than currently available bore water. Salinity will be higher (TDS = 1300 mg/L) than much of the bore water currently used and the sodium absorption ratio of the reclaimed water (related to soil sodicity) is double that of bore water currently in use. Reclaimed water use will require shifts in nutrient



Map showing different crops based on satellite imagery

management and adoption of appropriate irrigation practices.

Field experiments are aimed at identifying a cost effective soil additive to maintain/improve soil fertility when irrigating with reclaimed water. Lime, gypsum, green compost, biosolid, water treatment residual and industrial wastes are being tested. In the first year of this experiment, gypsum has shown to be the best additive in improving soil sodium absorption ratio. However, gypsum has also increased cadmium concentrations in some crops in this year.

To determine if plant nutritional demands through the season are met by the nutrients in the reclaimed water used for irrigation, nutrient budgets are currently being assessed on potatoes. Excessive nutrient loadings may lead to excessive vegetative growth, nutrient imbalances or environmental problems.

Other research has shown that increases in salinity of irrigation water increase cadmium uptake by the plant. Experiments in glasshouses found that cadmium uptake by lettuce was not affected by water quality (bore compared with reclaimed water). Yet, cadmium concentrations in lettuce were significantly reduced through appropriate irrigation scheduling. Further work is required to confirm these findings for potatoes grown in the field.

Much of this work has been communicated to growers through a field day/workshop held in April this year (Soil and Water Irrigation. Best Management Practices). A presentation was also given to the local Land Management Group, outlining findings of the project so far and introducing some new methods of irrigation scheduling and soil testing.

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Pest and disease management

Biofumigation - bioactive brassica rotations for IPM of soil-borne pests and diseases

(VG - Project started July 1997)

Work has continued on evaluating the types, amounts and toxicity of various fumigant-like compounds in a range of brassicas and measuring the growth of various types to determine their agronomic characteristics in different potato-growing regions.

A field day at Busselton, WA in November 1998 gave south-west growers an opportunity to view a range of contrasting types of brassicas, ranging from short, leafy, non-flowering fodders that have high levels of biofumigant compounds in the roots, to tall stemmed flowering mustards that have high levels in the stems and leaves.

Collaboration with plant breeders is seeing increasing attention being turned to selecting and developing lines specifically aimed at maximising biofumigation potential, as presently available lines are those that have arisen out of oilseed and fodder breeding programs which are generally aimed at reducing the pungent chemicals that produce the fumigant-like compounds.

The twice-yearly *Biofumigation Update* newsletter produced as a component of this project is now sent to about 450 interested growers, consultants and researchers. The newsletter aims to disseminate information related to biofumigation or similar options related to soil-borne pest and disease suppression and facilitate direct contact between people in all fields. It is free and available by contacting John Matthiessen.

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Characterisation of Australian isolates of Phytophthora infestans and planning to manage new and more aggressive strains.

(PT - Project started January 1999)

Potato late blight (Irish blight), caused by the fungus *Phytophthora infestans*, is at present a minor disease on potatoes in Australia and can be effectively controlled through the application of fungicides such as metalaxyl (Ridomil®).

In North and South America, Europe, Africa and throughout Asia, the disease has made a huge comeback over the last two decades after new strains escaped from central Mexico and rapidly spread to most potato growing areas. These new strains are more aggressive, cause extensive tuber rot, and rapidly develop resistance towards metalaxyl. In parts of the world where late blight was effectively controlled in the past, it has now become the number one potato disease.

From samples collected and field observations in the 1998-99 growing season we have limited evidence to suggest that Australia is still free of these new strains. The aim of this project is to use DNA fingerprinting to provide solid evidence that Australia is still free of these new strains of late blight, to take action to prevent introduction of new strains on tomato or potato imports, as well as developing management strategies to minimise the impact of the new strains should they be introduced. An information leaflet outlining the disease symptoms is currently being produced and further late blight sampling is planned for next season.

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Development of extreme resistance (immunity) to common scab disease within current commercial potato cultivars

(PT - Project started July 1998)

Common scab disease is the greatest economic constraint facing the French fry industry in Australia and is an important disease world-wide. Presence of this tuber-borne disease also threatens seed export markets.

Management options for disease control are limited. This project aims to enhance the natural resistance of potato cultivars to the disease using novel breeding procedures.

We aim to produce clonal lines of *Russet Burbank* and other important varieties with enhanced disease resistance using tissue culture selection techniques.

The disease organism produces a toxin which causes the common scab symptoms and which must be present for scabs to develop. Selecting potato lines with extreme tolerance to this toxin will give rise to highly resistant or immune plants. Unlike genetic engineering approaches, this will not be limited in its commercial application.

Dr Greg Luckman, a scientist with considerable experience in tissue culture techniques, has been employed on the project to facilitate the work. We have purified the toxin in bulk from local strains of the pathogen and we have also established tissue culture lines of various potato cultivars including *Russet Burbank* and *Shepody*.

The next step is to apply the toxin to the tissue cultured potato to begin selection of tolerant cells. Tolerant cells will then be regenerated into whole plants for disease resistance screening.

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Enhanced biodegradation of soil-applied pesticides - determination, risk assessment and prevention strategies

(HG - Project started February 1999)

Enhanced biodegradation occurs when soil microbes use the pesticide as a nutrient or energy source, breaking down the material so fast it no longer works as it should. Repeated applications makes the problem worse and eventually the chemical becomes completely ineffective.

It is a more widespread problem than is often realised, especially in intensive production systems like horticulture where modern non-persistent pesticides such as the organophosphate and carbamate insecticides, nematicides and fungicides are widely used.

Metham sodium soil fumigant, as a carbamate, is susceptible to the problem and it is initially the primary focus of the project. Metham sodium use is rising dramatically in Australia in response to pressures such as the global methyl bromide reduction strategy and the ever-increasing demands of the market for high quality, blemish-free product.

A post-doctoral research chemist, Ben Warton, was appointed to CSIRO Entomology in Perth in February 1999 to set up a new analytical laboratory and commence investigating the breakdown of metham sodium. The equipment is operating to required standards and the rate of breakdown of metham sodium after application is currently being defined for several soils to set benchmarks.

As a general rule, frequent applications of modern pesticides to one area of soil should be avoided. Once the problem develops, it can take a long time to fix.

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Influence of rotation and biofumigation on soil-borne diseases

(PT - Project started July 1999)

The aim of this project is to study the effects of different crop rotation strategies on diseases caused by soil-borne organisms.

As part of this work various brassicas were tested in the laboratory for their effect on the growth of the potato pathogens that caused pink rot, rhizoctonia stem canker and black scurf, verticillium wilt and black dot.

Indian mustard meal, a by product from the oil extraction from seed, and dried leaves of Indian mustard, fodder brassica and white radish were tested. Indian mustard meal was the most potent of all material tested.

Species of *Phytophthora* that cause pink rot were the most sensitive to the fumes from mustard meal, which retarded growth at low concentrations. Species of *Rhizoctonia* were the next most sensitive, followed by *Verticillium*. The black dot fungus was the least sensitive. Fumes from leaves of the Indian mustard were less potent than those from the meal. Fodder brassica was less potent than the Indian mustard and white radish was the least potent of all.

These studies give a guide to the potential of different brassicas as biofumigants against potato pathogens and show that the pathogens vary in their sensitivity to these chemicals.

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Common scab disease of potatoes and development of control methods

(PT - Project started July 1996)

Chemical control methods offer the most promising tool to help growers control common scab in the immediate future. Therefore, the main objective of this project is to identify and develop potential chemical control methods.

The relevance of infected potato seed in causing common scab on new tubers was studied in 1998. A total of 37 seed lines of *Russet Burbank* were examined with many certified seed lines showing low levels of common scab infected seed pieces. Seed pieces that came from an infected seed line but showed no common scab lesions were still able to transmit the disease onto new tubers. The severity of the disease on the new tubers was strongly related to the severity of the disease on the seed tubers.

A range of chemical products was evaluated in pot trials for scab control. All seed used in the trial had visible common scab lesions. All mancozeb-based products, Pencozeb, Dithane, Tato dust and Tato bark, reduced the incidence and severity of common scab infections in new tubers. The level of common scab control achieved with mancozeb was similar to that achieved with Shirlan and Maxim.

In field trials, the effectiveness of seed treatments was less evident, due to the presence of common scab inoculum already in the soil. This indicates that seed treatments were effective only in controlling the common scab disease from infected seed lines. Other methods of treatment are required for the control of the disease when it is due to soilborne inoculum.

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The national strategy for the management of western flower thrips and tomato spotted wilt virus

(HG - Project startedJuly 1997)

The risk of potatoes becoming infected with Tomato Spotted Wilt Virus (TSWV) has been highlighted recently with some crops in south eastern Australia suffering quite severe losses. Outbreaks of TSWV have historically been sporadic with some cultivars being more susceptible than others.

TSWV - Stunted potato in centre

The National Strategy team has been working on an integrated approach to manage this pest and virus combination. The project has organised permits for a number of insecticides from the National Registration Authority. Team members in New South Wales and Western Australia are conducting trials on those and other pesticides to establish efficacy, while in New South Wales, western flower thrips from populations around Australia are being tested for chemical resistance.

In Tasmania, studies on potatoes include virus transmission by cutting seed, comparison of tuber virus transmission in different cultivars and studies of the patterns of virus spread. Virologists in Western Australia have assessed methods of TSWV transmission and have assembled a collection of slides showing typical TSWV symptoms in a wide range of crops.

The project team thanks potato growers, HRDC and other industry contributors for financially supporting this strategy.

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New chemical treatments for fungal diseases of seed potatoes

(PT - Project started July 1997)

Two years of field trials showed that pre-plant seed treatments helped control seed-borne *Rhizoctonia solani* (Rhizoctonia stem canker and black scurf) but were not a "cure-all". Their effectiveness depended on location and cropping history.

Treating seed potatoes with Monceren®, and the as yet unregistered Maxim, significantly reduced the carry-over of the fungus to daughter tubers in new ground (no previous history of potato cropping) but were not as effective in old ground where existing *Rhizoctonia* populations contributed to disease. Maxim also reduced the carry-over of silver scurf in both old and new ground. In contrast, Rizolex® reduced black scurf incidence in old ground but not in new ground. None of these treatments significantly improved potato yields.

In a glasshouse trial, treating seed with Shirlan (not yet registered for potatoes in Australia) or a hydrogen peroxide based disinfectant, reduced the carry-over of powdery scab.

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Screening potato and vegetable soil borne diseases that may be controlled by Eucalyptus leaf mulch - pilot study.

(VG - Project started 1999)

This project aims to build on the finding by Dr. Jason Dennis that eucalyptus leaf mulch completely controlled onion white rot disease. Pot trials have been initiated to test whether eucalyptus mulch controls the following vegetable diseases: potato common scab, potato powdery scab, potato rhizoctonia, potato pink rot, clubroot in brassica and sclerotinia in beans.

The project has suffered delays due to a change in leadership of the project and to problems with plant establishment in the pot trials. Poor emergence and water logging in the pots meant that the pink rot, powdery scab, common scab, rhizoctonia and sclerotinia treatments needed to be repeated in order to obtain meaningful results. Due to dormancy requirements of potato minitubers, replanting the potato trials was delayed until July.

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Post harvest

Managing bacterial breakdown in washed potatoes

(PT - Project started July 1998)

Bacterial breakdown is a significant problem in washed potatoes throughout Australia. The disease is caused by Erwinia bacteria that rots potatoes in the field as well as in storage. In washed potatoes the disease often develops after the tubers have been processed and packaged, causing major losses to the processors and often resulting in consumer backlash.

Studies are underway to investigate the most appropriate means of managing bacterial breakdown of washed potatoes.

The first stage of this work was to determine the point along the washing line where potatoes became infected with the bacteria causing the breakdown. Tubers were taken from various sections along the washing line and then incubated in conditions of high humidity to induce rot. This showed that tubers became infected early in the washing process.

The problem has been made worse by the use of recycled water in many sheds in South Australia. As expected, tests on this water showed high levels of bacteria that were capable of causing breakdown.

Experiments are also underway looking at the use of various chemicals (such as bromochloro dimethlyl hydantoin, chlorine dioxide, calcium chlorite and benzalkonium chloride) to kill bacteria in contaminated water.

Other studies are looking at the relative susceptibility of different potato cultivars to breakdown.

Also on the drawing board is the construction of a mini washing plant. Once this has been made and installed we hope to evaluate a range of chemical and physical treatments that will control breakdown of washed potatoes.

We anticipate that on conclusion of this work in late 2001, we will be able to offer an effective management strategy to minimise the effect of bacterial breakdown on washed potatoes.

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Seed development

Aphid monitoring in the Scott River area of south-west WA.

(PT - Project started July 1996)

The south coast of Western Australia, particularly the area between Denmark and Albany, has been the mainstay of seed potato production in the State since 1922. The area is inappropriate for large scale production of export seed potatoes, as this traditional seed growing area is of limited size, which restricts the scope for crop rotation. Certain species of aphids found throughout Australia can carry viruses which pose a threat to seed potato production. The Scott River area located near the coast, south of the Brockman Highway, has been identified as potentially suitable for seed potato production, providing a possible alternative to the Albany area.

This project monitored the species of aphids active in the area during times of seed production (Nov – April). Sticky traps and leaf sampling was used to survey aphid activity at five sites. Between 0.2 and 3.9 aphids were caught per trap at each site every week. Of these, 67% - 89% were non-colonising aphid species, which are harmless to potato production.

From December to late January there were very low numbers of aphids recovered from leaves collected from crops at each site. Numbers of aphids started to rise after late January, and peaked at 5 aphids/20 lower potato leaves at one unsprayed crop.

Although numbers of aphids had started to rise in the unsprayed crop by late summer, sprayed crops had zero or very low numbers of aphids, showing that appropriate management techniques can suppress numbers. Whether such management can prevent or reduce the spread of viruses is unclear. Aphid pressure was minimal during the early stages of potato production in the Scott River Area in 1998-1999. The final report for this project is currently being written.

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DNA fingerprints and cryopreservation of potato cultivars for improved quality assurance

(PT - Project started July 1997)

Methods have been developed to rapidly distinguish and identify important potato cultivars using DNA fingerprints. Over the last two years we have screened the potato cultivar collections kept in tissue culture at IHD-Knoxfield and compared it to the field collection kept at IHD-Toolangi. This was very important because if the two collections were different then we could be perpetuating cultivar mix ups. Fortunately the collections were the same with a couple of exceptions.

We have produced DNA profiles for about 75 cultivars and are adding more as new cultivars are released. Already we have helped a number of growers identify their cultivars. Sometimes the news was good and on some occasions it was bad, but importantly the cultivar was correct.

Presently we are testing our methods to detect differences in the various clones of selected cultivars. For example in the tissue culture collection we maintain three clones of *Kennebec*, three of *Sebago* and five of *Delaware*. The question we are trying to answer is, are these clones really different and can DNA fingerprints be used to find out.

The other part of this project is to cryopreserve the less important cultivars that may be useful in the breeding program in the future. Cyropreservation is a method where material is kept in liquid nitrogen which is minus 196ºC and commonly used in medicine and by vets to preserve semen and embryos. We have cryopreserved at least 100 shoot tips of 40 cultivars.

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Improving seed potato production

(PT – Project started November 1998)

The project is investigating physiological age (p-age) in seed potatoes with the aim of developing practical measures of p-age which will allow prediction of sprouting pattern and plant vigour. This work is particularly relevant in the production of round whole seed as high stem numbers per set and good plant vigour are required for production of large numbers of small sized tubers.

P-age of tubers in store can be calculated using a thermal time or day degree model where number of days in store and temperature of the store determine the p-age. Unfortunately these calculations do not take into account the effects of crop growing conditions, maturity at harvest and other factors

which affect the dormancy and sprouting behaviour of tubers.

To demonstrate the problems with p-age calculations, the sprouting pattern of five *Russet Burbank* lines which were grown and stored under identical conditions was examined. Despite having identical p-age, there were large differences in the number of sprouts per tuber and the weight of sprouts produced.

Measurements of volatile chemicals produced by the potatoes in store as well as other biochemical tests appear to give a better indication of sprouting and vigour in tubers than p-age calculations.

The sprouting behaviour of tubers may also be manipulated by chemical or environmental treatments. Carvone and dimethylnaphthalene (DMN) have potential as treatments to reduce apical dominance (production of one strong sprout) and promote multiple sprout and stem production in physiologically young and vigorous tubers. These treatments will be assessed in field trials this season to determine their effect on stem density in crops and tuber number and size.

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Production and assessment of virus resistant potato cultivars

(PT - Project started July 1997)

This project is using genetic engineering to develop new cultivars and breeding lines with resistance to potato leaf roll virus and potato virus Y.

During the last 12 months we have continued to engineer the cultivars *Sebago*, *Crystal* and the breeding line *80-90-5* with new and superior resistance genes. So far we have produced a population of about 450 different lines. These are now being tested for their response to virus.

The tested process involves a number of stages and not all plants can be tested at the same time. Firstly we test in the laboratory to make sure the plants actually have the new genes. Secondly we grow the engineered plants in the glasshouse and inoculate them with virus and check their response. Plants that pass this test are then grown in the field. Our first field trial is to make sure the plants are true to type and to get tubers. Tubers are planted the following season in the field and inoculated with virus. While this process may seem long-winded it is the best way to efficiently screen our plants.

This season we did two field trials. One at Toolangi as a demonstration plot for the National Potato Field Day in February. The demonstration was to show growers the plants we are producing grow and yield as normal. We also have a trial at CSIRO's Ginninderra Research Farm near Canberra where plants have been inoculated with virus. While the final results aren't yet available the plants are growing as normal and the engineered lines are showing no symptoms of disease.

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Technology transfer

Coordinating technology transfer in the Australian potato industry

(PT - Project started October 1996)

The objectives of the project were to improve adoption of technology from the R&D program, improve communication within the industry and develop a national Code of Practice for Potato Cyst Nematode (PCN).

The Code of Practice was later expanded to include other diseases to make it more relevant to the day to day needs of farmers and to increase the likelihood of it being adopted. This resulted in this part of the project falling behind its original schedule. Current activities involve checking the proposed approach with farmers from regions across the country to refine what has been done. This is particularly important given the diversity of operations and growing environments in Australia.

Besides my ongoing roles of Assistant Editor for *Eyes on Potatoes* and *Potato Australia*, member of the APIC R&D Committee, maintenance and co-ordination of the distribution system, facilitating networking and assisting researchers in sorting out technology transfer issues, I have also had major involvement with two other HRDC projects over the last year. These are:

- Facilitating the introduction of electronic information products and services to the Australian Potato Industry
- Australian potato research and technology transfer conference

Another project to archive all the HRDC Final Reports and articles from *Potato Australia* and *Eyes on Potatoes* has been developed but its commencement has been put on hold till money becomes available.

One of the outcomes of the project will be a strategy for how the potato industry moves forward with respect to technology transfer. The strategy will build on what has already been done and provide a logical framework to help the APIC R&D Committee focus on what needs to be funded in the future. The strategy will become the Communication Plan for the industry and link in closely with the Strategic, R&D and Marketing Plans.

Many of the concepts for the Communication Plan have been discussed with industry groups over the last 18 months. Feedback from these discussions is being used to help prepare a draft Communication Plan for industry to comment on.

Forty to fifty technology transfer update workshops are being held around the country. Sessions on how to use the internet and how to write better research submissions are also being run.

Technology transfer information session at Gembrook, June '99

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Update on preparation of a Guidebook to Insects and Diseases in Potato Crops

(PT - Project started 1998)

Good control of insect pests and diseases in potatoes depends upon good identification. Although there is a reasonable amount of information scattered throughout scientific and other literature, there is no local up to date publication that specifically deals with the range of pests and diseases in Australian potato crops.

Growers wanting to use IPM (Integrated Pest Management) also need to correctly identify beneficial species of insects and there is even less information readily available about these. It is important for growers to have local (not overseas) information as most species of importance in potato crops are native to Australia.

We are producing a reference book for Australian growers, that will assist them to identify insects and diseases and also help them decide what action to take.

In addition to producing a reference book, we are also producing a small pocket field guide that can easily be carried into paddocks and sheds. This field guide will be provided free to all potato growers in Australia and will have photographic illustrations and text descriptions of the main beneficial insects, pests and diseases.

We are now just completing the text and photographs and the books should be available following the Potato 2000 conference in July 2000.

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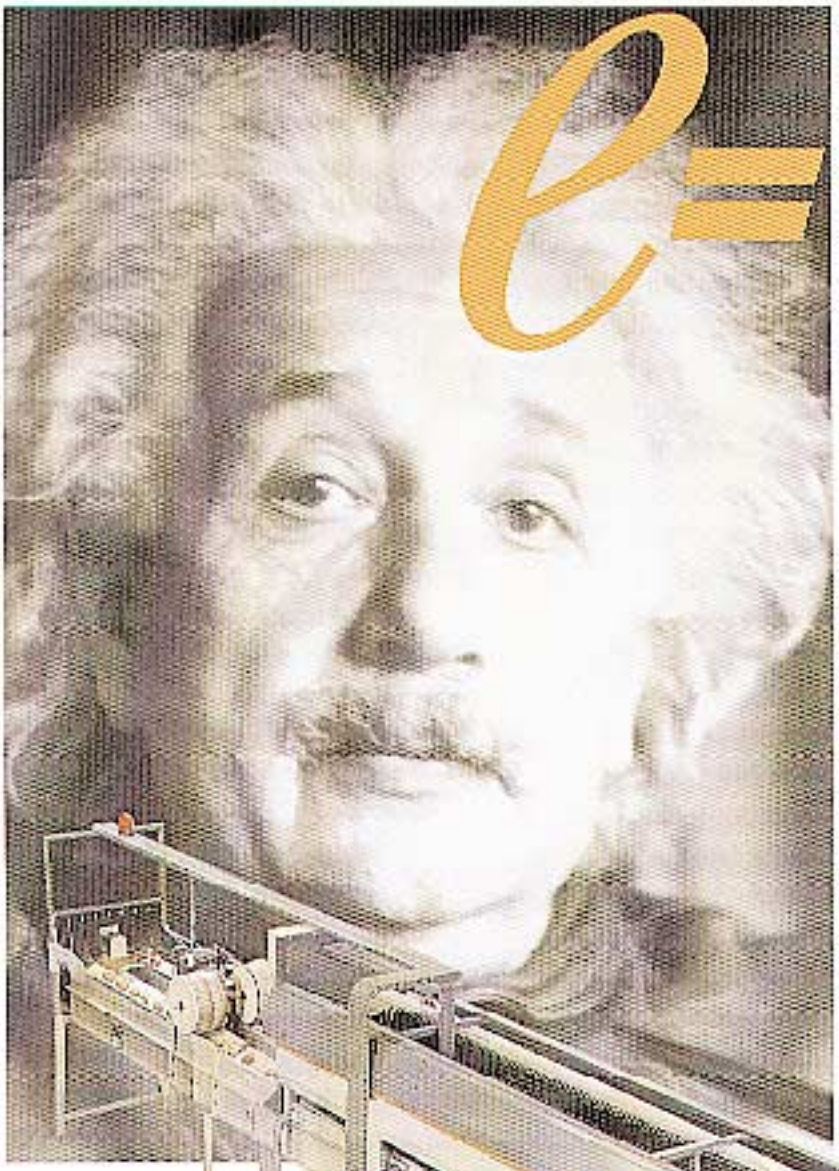

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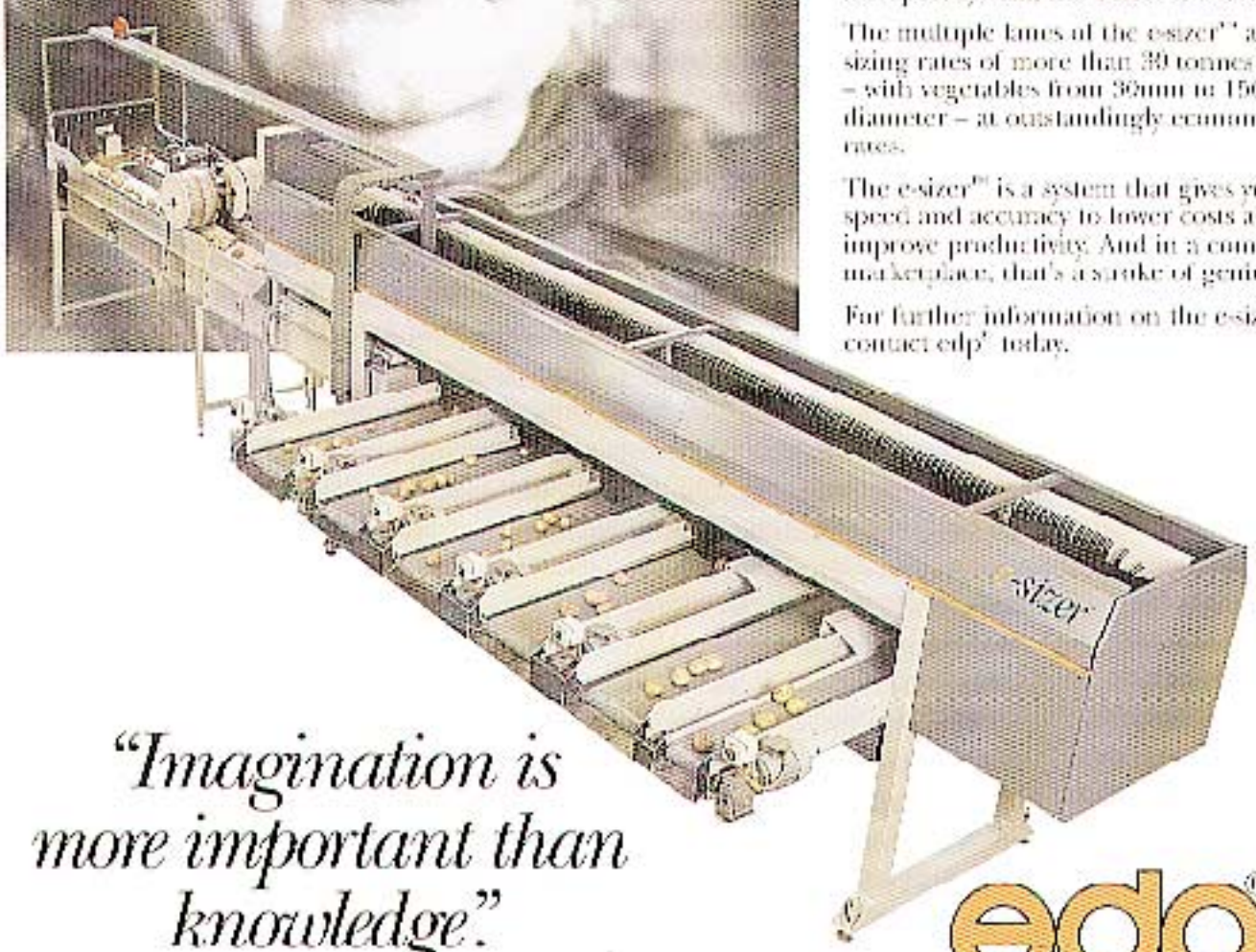

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New projects approved by HRDC

Crop management

Coordination of the National Cadmium Minimisation Strategy

Australian agriculture and horticulture is facing a potentially serious problem with cadmium. Cadmium is a heavy metal which accumulates in the body, especially the kidneys, and can cause renal damage and failure. It is becoming recognised world-wide as a long term health issue, and countries are increasingly likely to impose restrictions on the cadmium level of imported food. Australia has already rejected importations of peanuts from China on the basis of their cadmium levels.

Most Australian soils are naturally very low in cadmium. The elevated levels now being found in soils and in the produce grown on these soils, has mainly come from the application of superphosphate and other phosphatic fertilisers manufactured from phosphate rocks high in cadmium.

In the past some Australian produce, including some potatoes, has exceeded the Maximum Prescribed Concentration (MPC) for cadmium. Whilst there has recently been an increase in the MPC reducing the immediate concern, a long term solution is needed.

A Cadmium in Agriculture Task Force has been set up which has developed a framework for a national strategy for cadmium. The key elements are:

- the development of best management practices for those industries and/or areas which already have a cadmium problem. There are soil and crop management practices which can reduce the uptake by plants of cadmium from the soil.
- the fertiliser industry to target low cadmium fertilisers for those industries/areas which have an existing or potential problem with cadmium
- national guidelines for the use of biosolids and other organic wastes be kept under review for their impact on cadmium additions to the soil
- all fertilisers, trace elements and soil amendments (e.g. phospho-gypsum) be labelled with their cadmium content and a warning which alerts growers to the possible implications for the cadmium content of their produce.

To achieve these outcomes a part time co-ordinator will be employed who will monitor the success of the strategy, work with the various industries to develop best management practices, collect, analyse and interpret data on cadmium levels and best management practices and liaise with industry and the Australia New Zealand Food Authority.

The fertiliser industry is providing half of the funding for the co-ordinator with the remainder coming from the horticultural and grain industries.

Project duration: 5 years

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Determination of the biochemical and genetic factors affecting cadmium accumulation in potato tubers

The objective of this project is to investigate the biochemical and genetic factors involved in the uptake of cadmium from the soil by potatoes.

This will involve a biochemical investigation into the mechanisms of cadmium uptake, transport and storage by "high" and "low" accumulating lines and more detailed molecular investigation of the genes and gene products involved in these processes. This may allow the development of molecular markers to assist in the breeding of low cadmium lines by conventional breeding.

Other important issues to be addressed include how and where cadmium is stored within the plant and what factors influence the amount of cadmium stored.

Results of this work should allow more informed farming practices to be developed, the production of molecular markers to assist conventional breeding and will provide the potential to control cadmium levels in tubers via molecular breeding at a later stage.

Project duration: 3 years

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Potato tuber quality management in relation to environmental and nutritional stress

Consumers of potatoes do not like purchasing produce with unsightly disorders and may opt for alternative, more reliable and consistent products such as rice and pasta. A survey of marketers and growers of fresh potatoes in Queensland, NSW, Victoria and South Australia has highlighted the internal disorders, hollow heart and brown fleck, as major industry problems.

A survey of growers affected by these disorders suggests that the price on severely affected crops is downgraded by a minimum of 50%. In a particularly bad year it is estimated that brown fleck and hollow heart cost the Queensland and New South Wales potato industries more than 20 million dollars.

This project aims to develop a management package that will minimise the incidence of internal disorders in fresh market potatoes. This package will have the following key elements:

- develop and publish criteria for conditions which promote internal tuber disorders
- present to industry management strategies aimed at eliminating or minimising internal tuber disorders
- evaluate the effects of nutrition, irrigation and other management strategies (such as crop mulching and green top removal) on incidence of internal disorders
- educational workshops on management of internal tuber defects
- conduct technology transfer trials to extend new management practices for internal tuber defects
- screen new potato cultivars for resistance to internal disorders (as part of NaPIES program).

Project duration: 4 years

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Pest, disease & weed management

Pathology and detection of a novel potyvirus affecting potatoes

In Australia, potato virus Y and potato virus A are the only potyviruses that have been recorded as infecting potatoes.

During routine screening studies of Tasmanian gourmet potato cultivars by electron microscopy it was found that the Tasmanian cultivar *Pink-eye* was commonly infected with a potyvirus.

Initially this was thought to be potato virus Y, one of the most important potato

pathogens world-wide and the subject of routine screening in all certification schemes around the world. However tests have now shown it to be different from all known potyviruses.

It is thought that this new potyvirus is only in Tasmania. However, this is only an assumption because there is not yet a test for this virus. Therefore the risk to the potato industry is unknown.

This project aims to:

- develop a specific test for this novel pathogen for use in seed certification
- determine the relative risk of this virus to important Australian potato cultivars
- gain preliminary knowledge of the distribution of this pathogen in Australian potatoes
- fully characterise this pathogen for future reference.

Project duration: 1 year

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Phytotoxicity of metribuzin herbicide to different potato cultivars

Metribuzin is the major herbicide used on potatoes in Australia. There have been reports of metribuzin damage to commercial crops (reductions in yield of over 20%) for *Pontiac* in Western Australia, *Russet Burbank* in Tasmania and *Bison* in South Australia when metribuzin was applied at label rates of 300 to 500 grams of active ingredient per hectare. Increased metribuzin damage was associated with cool and wet soil conditions, sandy soils very low in organic matter and sensitive cultivars.

Field trials conducted overseas have shown that potato cultivars vary greatly in their sensitivity to metribuzin from minimal damage to significant crop losses.

Little research has been conducted in Australia on the sensitivity to damage of different potato cultivars to different rates of metribuzin under different growing conditions and whether reduced rates of metribuzin will provide effective weed control for sensitive cultivars.

There are many new cultivars of potatoes on the market (for example, *Bison, Red La Soda, Ruby Lou, Shine, Desiree, Atlantic, Ranger Russet*) that have not been tested for their sensitivity to metribuzin under the different growing conditions in Australia.

Preliminary work has indicated that lower rates of metribuzin are desirable for sensitive cultivars sown on sandy soils in the winter and that different potato cultivars can be ranked into different groups based on their sensitivity to metribuzin.

Bison was ranked as highly sensitive, *Atlantic* and *Pontiac* as moderately sensitive and *Coliban*, *Sebago* and *Desiree* as tolerant to metribuzin .

Further work is required to clearly establish relations between leaf damage (yellowing) and yield loss, to test the sensitivity to metribuzin of other new cultivars and to define efficient rates of metribuzin to achieve effective weed control and be non toxic to the range of commercial cultivars in use in Australia.

A voluntary contribution from Bayer Australia Limited is part funding this project.

Project duration: 3 years

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Post harvest

Increasing the opportunities for use of organic wastes in the Tasmanian vegetable industry

Organic wastes from farm, agri-industrial and municipal operations are potential sources of nutrients and organic matter for horticulture. The use of these materials could assist with environmentally sustainable production methods and help with efforts to meet market demands for environmental Quality Assurance requirements.

The project has four objectives:

1. determine the amount of organic waste available for horticultural end use in Tasmania, and the likely cost structures associated with end use options, using information currently being collected in an organic wastes inventory
2. identify alternative processing and reuse options for organic wastes
3. compare the relative economics and logistics of processing organic wastes for on-farm use in small scale on-farm, medium scale regional and large scale centralised operations
4. identify QA and HACCP issues relevant to food safety and environmental sustainability with regard to organic waste processing and reuse, and review these with respect to their impact on the further development of organic waste reuse as a component of sustainable agriculture.

Project duration: 1 year

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Seed development

An agronomic and economic blueprint for using whole, round seed for processing potatoes

Seed quality and planting efficiency have been recognised as key factors influencing the yield and returns for processing potatoes.

At present many seed lines contain tubers too large for efficient cutting resulting in many sets being poorly planted. The cut surfaces of sets can break down under adverse conditions resulting in poor stands, misshapen tubers and low yields.

This project is designed to evaluate the use of round seed *Russet Burbank* for Australia's processing French fry industry. Round seed should be a more reliable method of establishing potatoes.

Benefits to growers include better yield, size and returns. Benefits to processors include a more uniform raw material, higher recovery rates and lower costs. This has a national benefit as it improves the potential to compete against imports and possibly allow increased exports.

For commercial growers and processors to achieve these gains, however, seed growers must be able to successfully grow round seed profitably.

This project looks holistically at the seed grower, commercial grower and the processor to determine the agronomic and economic feasibility of using round seed.

Specifically, the study will:

- evaluate the role of laboratory produced minitubers in the production of round seed
- evaluate the role of mother seed treatments to improve yield or reduce costs
- measure the likely production costs for seed growers
- determine an equitable method of remunerating seed growers for round seed produced
- determine the economic benefits to commercial growers and processors from the use of round seed
- produce results which may be transferable to cultivars in the fresh potato industry which could improve its prospects of capturing a greater share of world round seed markets. This could possibly be confirmed in a supplementary project.

Project duration: 3 years

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AusHort

Horticultural industries co-ordinated response to the National Registration Authority's Existing Chemical Review Program

An existing project has contracted a consultancy team to help co-ordinate horticulture's response to the reviews of endosulfan, parathion ethyl and parathion methyl, and to suggest a plan for future responses to the National Registration Authority's (NRA) Existing Chemical Review Program (ECRP). The project steering committee has also been working with the peak industry bodies, the consultancy team, NRA, National Occupational Health and Safety Commission (NOHSC), agrochemical companies and other relevant parties to ensure a properly organised response.

The current project ends 31 July 1999, and a plan to extend it has been developed with the following elements:

- appoint a full time co-ordinator in July 1999
- increase the horticultural contact network - horticulture user groups and contacts (champions) for individual industries
- the co-ordinator and champions to assist industries to understand and respond to the ECRP
- liaise and negotiate with NRA, NOHSC, Agriculture, Fisheries and Forestry Australia and other relevant government bodies
- liaise and negotiate with registrants and relevant cropping industries
- conduct industry generic activities (e.g. worker exposure and residue protocols)
- assist industries to identify alternative treatments and implement outcomes of the reviews
- make recommendations to the HRDC via the AusHort R&D Committee, peak industry bodies about priorities, on going support, etc.

Project duration: 5 months (Stage 1)

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Horticultural Environmental Audit

The aim of Horticultural Environmental Audit is to document the use of natural resources by Australian horticulture, assess the extent of current impacts on those resources, both positive and negative, and assess current adoption of good management practices and its need to move to a more sustainable basis. It is being conducted jointly with the National Land and Water Resources Audit (NLWRA).

It is expected that the review will lead to the collection of data and information which can be used in planning and policy development, will identify any critical R&D gaps in the area of environmental management and indicate where R&D investment in environmental issues is likely to yield the greatest return for the horticultural industries. This will enable the development of a research and development plan for R&D in environmental management in horticulture, and help identify areas for industry skills development. Outcomes from the project will be available in October 1999.

Project duration: 4 months

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1999 World Trade Organisation research program for the Australian horticultural industries

The key objective of this project is to research and analyse international and domestic trade and government issues as they affect the Australian horticultural industries' competitiveness in world markets. This work will directly be used to focus the Australian Government negotiations at the 1999 round of the World Trade Organisation (WTO) in the USA.

The project will be conducted by the Australian Bureau of Agricultural and Resource Economics (ABARE) and will be linked to the considerable effort already put into the WTO preparation by the Rural Industry Research and Development Corporation and the National Farmers Federation.

The project will comprise two main parts:

a) The development of trade and market profiles for Australian horticultural industries, and

b) The analysis of these profiles, and undertaking of individual studies to establish important horticultural issues for Australian trade negotiators.

Project duration: 7 months

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AusHort – what is it all about

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There are an increasing number of research and development (R&D) projects that involve a wide range of horticultural industries. To deal with these projects HRDC in partnership with the horticultural industries has formed the AusHort R&D Committee.

Role

AusHort R&D Committee works in a similar way to the APIC R&D Committee except that it handles projects that involve a wide range of industries (ie. relevant to at least two thirds of the horticultural industries) and commissions most of the work.

Benefits

The cost of doing the work is spread across many industries so is less of a burden on any one industry. For big issues this can mean the difference between tackling an issue and not tackling it.

How much do we contribute

The potato industry, along with all other industries involved in the AusHort R&D program, contributes 5% of the levy funds which is then matched by the Commonwealth Government.

Who represents us

Our representative on the committee is the Chairman of the Australian Potato Industry Council (APIC) - Ian Rickuss, a potato grower from near Gatton in Queensland.

Projects being funded in 1999

- 1999 World Trade Organisation research program for the Australian horticultural industries
- Horticultural Environmental Audit
- Horticultural Industries' co-ordinated response to the National Registration Authority's existing Chemical Review Program ■

HRDC final reports available

At the completion of each research or development project an HRDC Final Report is produced. These are available from the Horticultural Research and Development Corporation for $20.00 each in Australia or $US20.00 outside Australia including postage. To obtain reports send a cheque or money order with a note quoting the project name/s and project number/s to :

Horticultural Research and Development Corporation
Level 6
7 Merriwa Street
Gordon NSW 2072
(02) 9418 2200
fax (02) 9418 1352
hrdc@hrdc.gov.au

Summaries from the HRDC Final Reports can be found on the new HRDC/AHC internet site at : ***www.horticulture.com.au***

Year completed	Project Title	Project Number
Crop management		
1991	Yield and quality effects of post planting applications of nitrogen & potassium to potatoes	PT016
1992	Potato irrigation - development of irrigation scheduling guidelines	PT004
1993	Improved productivity of the potato French fry industry in Victoria	PT015
1993	Improving market quality of ware potatoes	PT022
1993	Soil fertility management for potatoes on the Atherton Tablelands	PT012
1993	The control of volunteer potato plants in subsequent vegetable, pyrethrum and poppy crops	PT008
1994	A national survey of cadmium in potato tubers and soils	PT212
1994	Attendance at Potato Harvest 1994 Demonstration, United Kingdom	PT439
1994	Control of stem end browning of *Russet Burbank* potatoes	PT209
1994	Development of crop management strategies for improved productivity & quality of potatoes	grown on
1994	Effect of soil conditions & fertilisers on cadmium in vegetables - a national approach	VG006
1994	The development & application of an integrated crop management program for crisping potatoes in South Australia	PT339
1996	Improved irrigation management in potatoes and onions	VG407
1996	Improving international competitiveness of the French fry potato industry in SE South Australia	PT340
1996	Irrigation managment for crisping potato growers in southern Queensland	PT509
1996	Sustainable potato production in highland areas of Australia	PT337
1996	The reduction of cadmium contamination in Tasmanian vegetables and poppies	VG011
1997	Early production of French fry potatoes on the Swan coastal plain	PT653
National Potato Improvement & Evaluation Scheme		
1992	Increasing potato productivity in Queensland by cultivar development and improved management	PT011
1992	Potato variety evaluation for local, export and processing market in Western Australia	PT017
1993	Potato breeding and cultivar trials in Australia - Tasmania	PT204
1993	Potato breeding and cultivar trials in Victoria	PT223
1994	Utilising potato microtubers for field production of seed potatoes	PT115
1995	Evaluation of round potato seed in Queensland	PT314
1995	Potato breeding and cultivar trials in Australia - Western Australia	PT214
1996	Breeding crisp potato varieties	PT311
1996	Breeding French fry potato varieties	PT309
1996	Breeding fresh market potato varieties	PT310
1996	Molecular markers for PCN resistance	PT520
1996	Potato breeding and cultivar evaluation - Western Australia	PT515
1996	Potato breeding study tour to UK, Netherlands & USA, July 1996	PT625
1996	Potato cultivar accession and testing in Tasmania	PT343
1996	Potato variety improvement in New South Wales	PT519
1996	Production of virus resistant potato plants to enable reduced use of insecticides on potatoes	PT338

Pest, disease and weed management		
1991	Development of a test for potato leafroll virus & determination of PLRV strains in South Australia	PT009
1991	Rapid identification of Streptomyces spp. on potato, the key to integrated management of common scab	PT006
1993	Attendance at Potato Conference - Madison, USA	PT300
1993	Survey for the incidence of black dot of potato	PT221
1994	Control of black leg, black scurf and other postharvest storage rots of seed potatoes	PT105
1994	Development of a commercial assessment method to detect parasitoids of the potato moth	PT216
1994	Rapid detection, epidemiology & control of tomato spotted wilt virus in seed & processing potatoes	PT101
1995	An investigation of black dot disease of potatoes and its control	PT023
1995	Identification of potato cyst nematode pathotypes	PT346
1995	Integrated management of potato common scab	PT205
1995	International Plant Protection Conference and organic amendments for potato pest and disease control	PT517
1995	Polymerase chain reaction protocols for the detection of chrysanthemum stunt and potato spindle tuber viroids	PT410
1996	Comparative benefit cost of IPM and conventional pest management in potatoes	PT538
1996	Development of IPM strategies for potato moth	PT437
1996	Epidemiology and control of powdery scab of potatoes	PT303
1996	*Rhizoctonia* control on fresh market potatoes	PT315
1997	Characterisation and detection of potato cyst nematode	PT436
1997	Development of biological control for potato wireworm	PT406
1997	Integrated management of early and late potato blights in Australia	PT341
1997	National strategy for the management of western flower thrips	HG324
1997	Potato early dying in Australia	PT412
1997	Refining Potato Pest Management Practices in Australia - Sabbatical of Dr Walt Stevenson, potato extension specialist	PT603
1998	Attendance at the International Mycological Institute Fungal Identification Course, United Kingdom, August 1998	HG97038
Postharvest		
1991	After cooking darkening of potatoes	PT003
1993	Fresh potato market research	PT201
1993	To improve postharvest handling, storage & processing quality of *Atlantic* and *Cadima* potatoes	PT024
1994	An evaluation of viability of manufacture of potable spirits (vodka and gin) by the fermentation and distillation of potato biomass	PT448
1994	Review of potato waste utilisation in Australia	PT304
1995	Evaluation of the economic opportunities for potato by-product industries in Australia	PT409
1996	Use of natural sprouting inhibitors for potato storage	PT354
Seed development		
1992	Seed potato industry development (aphid monitoring)	PT018
1993	Improving seed potato handling technology	PT111
Technology Transfer		
1993	Decision support software for the nutrient management of irrigated potato crops	PT108
1993	Workshop packages for effective extension	PT321
1994	Development and extension of potato hygiene strategies	PT319
1994	Development & application of training programs for IPM techniques in Southern Australia	PT230
1995	Fresh potato industry technology transfer: Needs assessment & strategic recommendations	PT452
1996	Implementation of integrated pest management in Northern Australian potato production districts	PT336
1998	Spudnet, an electronic information system for Australian potato growers	PT97025

The Simpsons' story -

growing certified seed at Meerlieu

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The Simpson family, of Meerlieu in Victoria, have an interesting story to tell since they moved from an established and proven certified seed-producing district to a completely new area.

Russell, Marge and sons Brian and Alan, have had to adapt many of their management practices to suit this new area and have also expanded the size of their business. There are now two other growers also successfully producing certified seed in the Meerlieu district.

31 years of certified seed production

The Simpson family has been growing certified seed potatoes for 31 years under the Victorian Seed Potato Certification Scheme. Russell and Marge commenced growing certified seed potatoes at Warragul in 1968 and then purchased properties at Trafalgar South, then Thorpdale and more recently at Meerlieu.

While at Trafalgar South, the Simpsons developed their business to include foundation seed production for their fellow certified seed growers.

With the limited opportunities for expansion in the Thorpdale area, trial crops were successfully grown in East Gippsland at Meerlieu, which is about 40 km east of Sale.

"At this stage I had to make a decision to either stay at Thorpdale where land was limited and expensive or make a total move to East Gippsland," Russell said.

"The move to Meerlieu in 1993 was a major undertaking as there were no facilities for certified seed potato production on site. We had to install several bores and build a cool store, grading shed and staff amenities."

Alan, Brian and Russell Simpson in front of a bulker bag of Coliban certified seed ready for dispatch

Meerlieu as a certified seed production area

Some growers associate the milder climate of the east Gippsland area as being suitable for early production. However the Simpsons recognise that the milder climate allows them to produce their crops over a longer period. They commence planting in August for their early orders and plant through to January. The long season allows better use of labour and equipment as well as providing seed of the appropriate physiological age for a range of buyers.

'There are some downsides in this area as we are further away from most markets,' Russell admits. 'Also the climate can be a bit variable.'

Russell explained that the area has had its climatic challenges with a drought, including the driest two years on record, followed by the wettest period on record.

Russell has learnt from experience that the soils do vary and the areas to be used for potatoes must be carefully selected. They prefer to use sandy loams that have a pH of about 5 for potato production. The soil preparation methods have had to be extensively changed to suit the local conditions. Bore water is used to irrigate all crops.

Varieties grown include *Coliban*, *Sequoia*, *Sebago*, *Crystal*, *Desiree*, *Atlantic*, *Nadine* and *Shine*. All seed is derived from minitubers produced by laboratories accredited by ViCSPA and multiplied to sell as certified seed at generation 4 or 5.

Quality Assurance

The Simpsons are registered quality assurance growers under the Victorian Certified Seed Potato Authority's (ViCSPA) QA program. Their manual specifies quality controls for all stages of production and grading to ensure that quality is built into their product.

When asked what are the advantages of being in the QA program the Simpsons listed the following:

- they are more aware than ever of the quality of their produce
- their grading staff takes more interest in their work and are prepared to accept greater responsibility
- the QA program has enabled them to move to the Meerlieu area - it would not be economically feasible for regular visits by the ViCSPA contractor to carry out tuber inspections
- they must keep good records which are needed for good management and continual improvement

- they are able to trace back any problems or concerns
- they have the ability to carry out the tuber quality checks for final certification themselves which allows greater flexibility and better time management
- the savings made on the tuber inspection fees

"It took me a little while to get used to the idea of having to implement the quality controls and keep records but the boys quickly grasped the concepts. Brian and Alan have now been involved with the QA program for most of their seed growing careers," Russell said.

Field inspections

All crops grown by QA growers receive at least two field inspections during the growing period. In the Simpsons' situation, Alec Duff from Gippsland Inspection Services and who is the local ViCSPA contractor, conducted field inspections of crops from October through to April.

Hygiene management

The Simpsons place a high emphasis on good hygiene protocols. Their hygiene protocols include:

- the only potatoes brought onto the property are from ViCSPA accredited laboratories
- no secondhand machinery is purchased or used on their property
- early generation seed is harvested into washed and disinfected bins
- the shed and grader are washed and disinfected between seasons
- the seed cutter is washed and disinfected after every lot and or variety and normally at each tea break
- the planter is also disinfected between varieties and generations
- staff cars are parked on a hard standing area away from the shed and grading area
- all cultivations in the growing crop start with a clean implement and tractor and always move from a younger to an older generation
- only cleaned 'used' buyers bins can be bought onto the property

The Simpsons believe that their district has a good future for certified seed production.

"We would like to see the district proclaimed as a Plant Protection District to help ensure that unwanted pests and diseases are not brought into the area," Russell said.

Soil borne diseases

To date soil borne diseases have been of little concern. However *Rhizoctonia* is present in all soils and can cause problems in favourable conditions. This past season *Rhizoctonia* has been successfully controlled using *Monceren*®. An untreated area left for comparison distinctly showed the improvements gained from using this product.

Industry trends

Russell Simpson is a current board member of ViCSPA and has actively been involved in the certified seed industry at local and state levels. Looking to the future of certified seed production he sees:

- the number of seed producers will decrease as their age increases and it becomes more difficult to sustain the current levels of profitability.
- overall production of certified seed will increase
- seed producers will have to be much more aware of their buyers needs and requirements. This process involves some difficulty, as there may have to be some compromise reached between the ideal seed tuber and what can be produced under the limitations of soils and climate
- room will remain for both direct sales and sales via merchants. Both systems have their place.
- there is a need for a longer seed production season to supply markets all year
- better utilisation of labour and equipment by seed producers will reduce costs
- improved economy of scale will be achieved by large businesses or by growers sharing equipment and or by the use of contracting. These changes will allow the industry to keep up with the introduction of new technology and equipment for harvesting and grading.

Looking at the greater industry focus he believes that the following will assist in industry development:

- encourage and support young people into the industry
- certified seed industry and its organisations must carefully listen to and respond to the needs of the broader industry
- support for the concepts of community packing sheds and harvesting equipment
- continued focus on the supply of seed of uniform quality at an economical price
- continued support of the traditional and new areas for seed production as future expansion in the industry will come from the latter areas as is now the case in the fresh and processing industry. ■

An early crop of certified seed at Meerlieu. The yellow pan is an aphid trap to check for aphids

How to sell more potatoes

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The potential for large increases in potato sales has been demonstrated by a project aimed at developing a quality assured production and marketing system for fresh potatoes.

The increases were made possible by combining the efforts of farmers, through good grading and handling practices, with improved standards of presentation at the retail level.

The project was developed jointly between the Queensland Department of Primary Industries and Queensland Fruit and Vegetable Growers in response to a number of studies which highlighted areas where improvement and a better understanding is needed of quality, marketing, quality management systems and food safety.

Market trial

A market trial focusing on packaging and stock rotation was conducted in November 1998 by a pilot group of volunteer growers in the Lockyer Valley in south east Queensland.

Well presented paper bag display

Packaging

This part of the trial investigated the use of a 16 kg retail ready carton and compared it to loose displays where the potatoes were supplied to the retail outlet in a paper bag (Paper bags were evaluated in a previous trial and published in the 1998 edition of *Potato Australia*).

Ready retail cartons provide uniform retail displays

A retail ready carton is a carton that is placed directly onto a produce display in a retail outlet instead of displaying the potatoes in a loose bulk type display. Most current use of cartons is as an alternative to bags for supplying loose bulk displays.

It was assumed that the use of a retail ready carton would help to improve stock rotation and hence the appearance and sales of the potatoes. However, the use of cartons adds significant cost to the price of the potatoes so the aim of this trial was to establish the merits of such a change.

Stock rotation

Why do retail ready cartons improve rotation? As consumers take potatoes off loose displays they always tend to leave behind the defective, older less appealing potatoes. As the level of defects increases on the display the overall appearance of the display declines which then reduces sales as consumers buy other food that looks better.

By using the retail ready cartons staff in the stores were able to simply remove the remaining defective stock by taking the nearly empty carton off the display and replacing it with a fresh carton. If there were still some good potatoes left in the carton it is a simple matter of placing these few potatoes on top of the fresh box so they are purchased first, thus ensuring perfect stock rotation.

Participating stores

Three groups of retail outlets selling premium loose brushed *Sebago* participated in this trial.

Two of the three groups were supplied by the pilot group. One of these used the retail ready format whilst the other had loose bulk displays supplied to the stores in 20 kg paper bags.

The third store group acted as a control or reference group. They were not supplied by the project growers and did not change their presentation methods or standards but potato sales and quality were monitored in the same way as for the other two groups of stores.

During the trial information was collected on sales and the level of defects was monitored before the potatoes left the packhouse and when they arrived at the store.

Trial results

The stores with the potatoes from the pilot QA growers increased sales by up to 50%!

The stores carrying the loose line (supplied in paper bags) improved sales by 52% over the control whilst the stores carrying the retail ready carton displays improved their sales by 16% compared to the control (see graph).

As predicted the carton stores showed improved sales and improved stock rotation. The higher level of sales in the paper bag (loose display) group was unexpected as poor stock rotation should have slowed sales compared to the retail ready carton stores.

Further investigation revealed that the staff involved in the trial put in extra effort keeping the loose displays well presented and thus produced significant

	Retail ready carton display	Loose display	Control
Major defects (%)	2.04	1.50	2.21
Minor defects (%)	3.64	2.27	5.79
Over weight (%)	1.34	1.23	1.73
Under weight (%)	0.40	0.68	2.20
Total out of Specification (%)	**7.42**	**5.68**	**11.93**

increases in sales.

The trial resulted in two significant outcomes.

1. The retail ready cartons improved display presentations and hence sales.
2. The improvement in sales in the loose display stores showed significant potential for improved sales when extra time was taken at the retail level to maintain displays.

Scrutiny of the quality control results for the three store groups (see the table) shows the total level of defects to be much higher in the control group.

This means the consumers purchasing potatoes from the trial stores were presented with more consistent quality produce than those shopping in the control stores.

The price of produce was also recorded on the sales graph and shows no impact on the changes in sales.

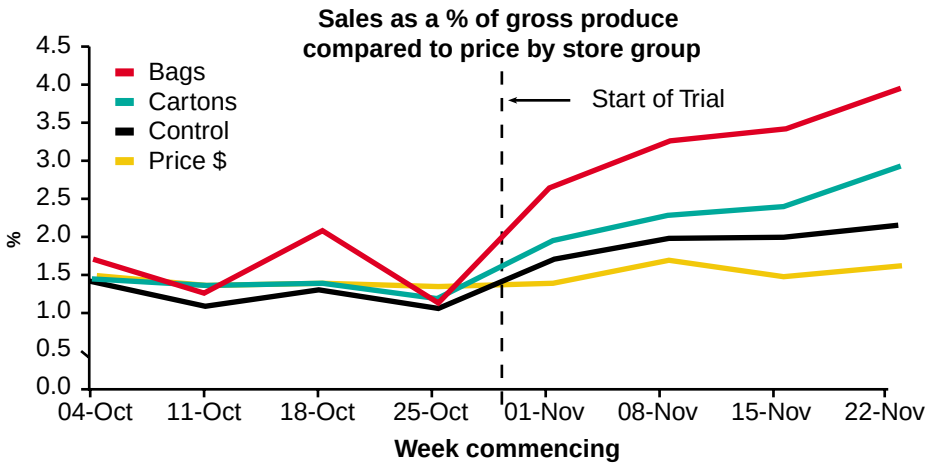
Quality control shown as percentage of defects across store groups.

This trial clearly demonstrates that when everyone involved in the marketing chain improves their packaging, handling and display of potatoes, substantial gains can be achieved. Also once again it has clearly demonstrated that price is not always the governing factor.

When low prices are used to market potatoes, profitability is reduced for everyone in the supply and marketing chain. The flow on effect is a reduction in the amount of time and effort that can be put into correct handling and presentation, the very factors that have the potential to increase sales. In fact consistently graded potatoes that are then well presented at the retail level have the potential to improve potato sales by up to 50%.

Acknowledgements

The assistance of HRDC, Valley Fresh Co-operative, Growpak supplies, Lindsay Brothers transport, Peter Case of QDPI and the Lockyer Valley QA pilot group is gratefully acknowledged.



New varieties for the potato industry from NaPIES

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Varieties being tested by the National Potato Improvement and Evaluation Scheme (NaPIES) are creating increased interest within the potato industry. Improved yields and quality with these varieties has shown the continuing value of a national cultivar testing project for the Australian potato industry.

Correct variety selection is one of the essential inputs for a profitable and sustainable potato industry in Australia. To ensure the industry has independent, unbiased and useful information on which to base variety selection, new cultivars need to be evaluated against existing commercial varieties in a series of trials in major growing regions, to obtain valid results for that region. This ensures that new varieties are not promoted above, or below, their value to local industry due to a lack of information.

The NaPIES program provides this service to industry through a national network of evaluation trials.

Most of the major potato varieties used commercially in Australia, have been bred in Australia or else introduced from overseas and tested through the NaPIES program. Examples of these varieties include *Coliban*, *Desiree*, *Crystal*, *Bison*, *Atlantic*, *Spunta*, *Nadine*, *Shepody* and *Wilstore*.

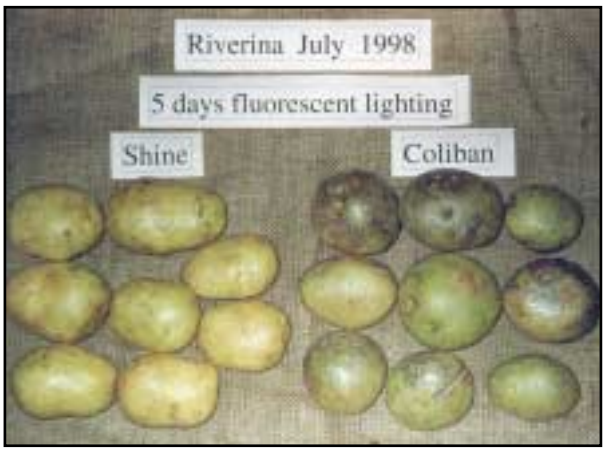
This article reports on the results of some of the most prominent varieties from the testing program and their status for commercial adoption within the industry.

FRESH MARKET

Shine

Victoria, South Australia, New South Wales & Queensland

Shine has produced high yields when harvested in winter in the southern Riverina of New South Wales and the South Australian Mallee. It has a short growing period and short dormancy which means it is suited to double cropping from kept seed areas such as the Riverina and Riverland, the South Australian Mallee and the Lockyer Valley, Queensland.



Fluorescent light comparison of Shine and Coliban

Shine has excellent tuber appearance with round regular shaped tubers and smooth, bright, white skin making it suitable for the premium priced washed fresh potato market.

It has excellent flavour and is excellent for boiling. The boiled product is white with no after cooking darkening. Potatoes remain fairly firm during boiling and do not disintegrate or slough.

Shine has been bred by the NaPIES program at Toolangi and selected from trials on commercial properties in various production areas in Australia. *Shine* has been tested in New Zealand for reaction to Potato Cyst Nematode and is resistant to PCN Ro1, the only strain which has been found in Australia.

Shine was grown on commercial properties this season and very limited amounts of certified seed will be available again this season for testing by commercial growers.

Planting a variety trial at John Doyle's property at Berrigan, NSW

White Rhino

Queensland

White Rhino (86-31-5), has shown potential for a number of years now. It does not appear to be affected as much by soft rots which attack *Sebago* crops. Last year small commercial plots were grown but due to the harsh conditions, product was not able to be marketed. This year *White Rhino* is again being grown on a small commercial scale and market evaluations will be made. *White Rhino* has been specifically developed from the breeding program for North Queensland and has not performed well in southern Australia.

Ruby Lou

South Australia, Western Australia, New South Wales & Queensland

Ruby Lou (bred in NaPIES program) has a smooth, red skin, with sheen and is resistant to shatter crack and skinning, making it suitable for the washing market.

Its short dormancy and early bulking make it suitable for the double crop systems in the Mallee and Riverland of South Australia, the Riverina of New South Wales and the Lockyer Valley in Queensland.

Ruby Lou retains most of its red skin colour and sheen for one or two months after maturity when stored in sandy soils in the winter months in the Mallee, so it has good potential as a winter, red washed potato.

In the South Australian Mallee, *Ruby Lou* produced No. 1 grade yields of 41.3 t/ha compared to *Desiree* 33.8 t/ha and Red *Pontiac* 31.8 t/ha for winter harvested crops (averaged from three trials over three years).

In Queensland, *Ruby Lou* yielded 52.7 t/ha No. 1 grade in 1996-97 which was comparable to *Pontiac*.

This variety is also being tested commercially in Western Australia and is performing well. It has been evaluated in small commercial plantings in the Riverina of New South Wales.

Small quantities of tuber seed are available for this variety for growers to try small scale commercial plantings.

Ruby Lou tubers - oblong shape and red skin with sheen

Winter Gem

Western Australia

Winter Gem was bred by the NaPIES program at Toolangi, tested as *90-105-16* and selected for its performance in Western Australia.

Winter Gem produces good yields of round, smooth skinned, white fleshed tubers. Its best performance has been in winter where it performs better than *Delaware*.

Winter Gem coming through the wash packers

Winter Gem's benefits over *Delaware* are:

- improved shape and appearance
- superior skin bloom
- more versatile culinary quality with good taste
- better wind tolerance
- resistance to potato cyst nematode Ro1
- improved powdery scab tolerance

Harvesting Winter Gem at 'Baldivis Market Garden'

WA growers have delivered commercial tonnages to packers over the last two winter crops. It's exciting that *Winter Gem* yielded as well as *Spunta* which is renowned for its high winter yields. The market has shown a preference for round, white potatoes and this gives *Winter Gem* an advantage over *Spunta*. *Winter Gem* has the potential to be a more profitable winter variety than the current varieties. Pack outs from last season's winter grown crops show *Winter Gem* had more Premium grade, less Class 2 and less waste.

Winter Gem should please consumers, not only because it has excellent appearance, but because it also has versatile cooking quality. *Winter Gem* has good taste and good to excellent mashing quality. *Winter Gem* is also good for microwaving and it produces acceptable French fries for domestic consumption.

Variety	Taste	Salad	Mash	Microwave	Fry
Delaware	**	**	*	**	*
Winter Gem	**	*	***	**	**

Potato Marketing Corporation ratings
*** = excellent, ** = good, * = fair

FRENCH FRY

Ranger Russet

Tasmania & South Australia

Ranger Russet was bred in the USA but introduced and tested through NaPIES. It produces long, blocky shaped tubers for French fry production. It has potential to fill the niche production time as a direct delivery variety after *Shepody* and before *Russet Burbank* in the lower south east of South Australia.

Harvesting a variety trial at Forthside Vegetable Research Station, Tasmania

Ranger Russet is now grown commercially, primarily in the north east of Tasmania on marginal sandy soils that are not traditional potato growing areas. *Ranger Russet* appears to be more suitable for production on such soil types than commercial varieties which do not perform very well under these conditions.

Although this variety differs little in yield to *Russet Burbank*, it has better processing characteristics than *Russet Burbank* with little or no internal defects and better tuber shape. This allows for a better recovery when processing and a subsequent better return to the industry.

With a growing season later than *Shepody* but earlier than *Russet Burbank*, *Ranger Russet* fills a key production niche time for the industry. Approximately 3000 tonnes of *Ranger Russet* were processed for the 1997/98 season in Tasmania.

Umatilla Russet

Tasmania

Umatilla Russet is an imported variety (USA) that is displaying excellent potential as a supplementary variety to *Russet Burbank* for the French fry industry in Tasmania.

Umatilla Russet is continuing to be investigated in commercial trials by the processing industry.

It has a better recovery rate than *Russet Burbank* due to the lack of internal defects and a more even tuber shape. Fry grade tuber yield is superior to *Russet Burbank* with an average yield of 63.1 t/ha compared to 58.5 t/ha (averaged from twelve field trials conducted over the past three seasons).

With a growing period slightly shorter than *Russet Burbank*, *Umatilla Russet* is creating much interest within the processing sector as a variety capable of supplementing the start of the *Russet Burbank* production season.

Harvested Umatilla from NW Tasmania

CRISPING (EXPORT)

Dawmor and Hart

Western Australia

Dawmor and *Hart*, suited to the export trade of crisp raw product, were released at Manjimup in March 1999. They were tested on a commercial scale by Agritrade International Pty Ltd (Agritrade) which became interested in the benefits these varieties offered after seeing their performance in demonstrations run by Agriculture Western Australia.

Dawmor was tested as 89-55-6 and its parents were *Tarago* and *Lindsay*. *Dawmor* performs best when grown over summer where it has round shape with high yield (averaging 84% higher than *Atlantic*), high dry matter (20.4% v 18.9% for *Atlantic*), good fry colour and only half the internal disorders of *Atlantic*.

Dawmor averaged more than 11 tubers per plant while *Atlantic* set just over seven. This means *Dawmor* can be planted at a lower density than *Atlantic* to give savings in seed costs. In other growing periods *Dawmor* tends to become oblong.

Dawmor shows its round, even shape and size

Hart was tested as *90-73-11*, its parents were *Patrones* and *Lindsay*. *Hart* has performed well over summer at Manjimup and during spring and autumn on the Swan Coastal Plain. In October plantings it has a much higher yield than *Atlantic*.

Hart sets over 10 tubers per plant and so can also be planted at a lower density than *Atlantic*. Dry matter is also higher than *Atlantic* with October planting's averaging 21.1% against 18.5% for *Atlantic*.

Fry colour is similar to *Atlantic* and internal disorders are lower. The shape is oblong and, while not acceptable for some domestic crisp processors, it is acceptable for the export trade.

Acknowledgements

We would like to thank growers, processors, potato packers and The Potato Growing Industry Trust Fund of WA who have helped with variety testing and we gratefully acknowledge HRDC and the APIC levy.

■

Further details of the performance of potato varieties in South Australia can be obtained by purchasing the booklet Potato Varieties for SA by Chris Williams and colleagues. The booklet, printed in 1997, contains 28 colour plates and 20 pages of trial results and discussion. Copies can be obtained by forwarding a cheque for $7 per copy to

SARDI Office
Lenswood Centre, Swamp Road

As part of the NaPIES program, demonstrations and field days are held in potato growing regions to demonstrate recently released varieties and the best new Australian and overseas varieties being tested.

In 1999, demonstrations and field days have been held at Penola (SA), Pemberton (WA), Toolangi (Vic) and Forthside Vegetable Research Station (Tas).

NaPIES Review

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The industry breeding and evaluation program (NaPIES) is currently under review. A workshop was held in Melbourne on the 3rd August involving the APIC R&D Committee, Horticultural Research Development Corporation (HRDC) and Department of Natural Resources and Environment. The purpose of the workshop was to determine the future direction of the NaPIES program.

Why the review

There were several reasons for the review. Large programs such as NaPIES need to be reviewed regularly to ensure they are still meeting the expectations of the industry. In the case of NaPIES a review was due. There was also concerns voiced by some growers and others in the industry about the success of the program and these needed to be considered. The overriding factor though was the cost of the program.

The cost of the program was climbing and impacting on what research could be funded in other areas. The program also needed expanding in some areas if we were to get the most out of what we were doing. The introduction of Plant Breeders Rights (PBR) also meant that new varieties were now being brought into Australia from overseas and being marketed so the program was no longer the only source of varieties. This latter point has also had implications on how the Victorian Government viewed their investment.

The Department of Natural Resources and Environment provide major support for the program and want to use PBR to make it more commercially focused and reduce the cost to the government. Before PBR, this was not an option as there was not the ability for the program to attract a lot of external investment because companies had no effective mechanism of achieving a return on that investment, particularly in the fresh market.

Outcome to date

Although it was hoped a decision could be reached at the workshop, this was not so. It was clear though that for each of the main industry sectors, French fry, crisping and fresh, there will be different approaches to trialing new varieties. The process of revamping the program has proved to be very difficult. Further work is being done and the issue will be considered again at the October Research and Development meeting. ■

Varieties make a difference to cadmium

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The potentially toxic heavy metal cadmium has recently been put under the spotlight by health authorities.

In Australia a maximum permitted concentration (MPC) of 0.1mg/kg for cadmium in potatoes was set in 1997.

Cadmium monitoring is an essential component of potato quality assurance systems, therefore potato producers need to be aware of the importance of management practices on cadmium levels in tubers. There are several important factors which affect the uptake of cadmium by potatoes (see CSIRO brochure, *Managing cadmium in potatoes for quality produce*, which was distributed nationally in the March 1999 edition of *Eyes on Potatoes*).

The choice of potato variety is one factor which can have a major impact on cadmium levels in tubers. As part of the industry funded potato variety evaluation program in Western Australia, promising crossbreds and new varieties are compared with existing varieties for tuber cadmium levels. This is done in replicated trials in sites where moderate to high tuber cadmium levels have previously been obtained.

Results are shown in the table, where tuber cadmium is expressed as a percentage of the concentration of the fresh market variety, *Delaware*. The average tuber cadmium concentration of *Delaware* at the seven sites was 0.068 mg/kg fresh weight.

Nadine and *Kennebec* are high cadmium accumulators which means they produce tubers with higher cadmium concentrations than most potato varieties grown in Australia. *Coliban*, *Sebago* and *Delaware* are medium cadmium accumulators.

For growers in regions which have shown moderate to high tuber cadmium levels with a 'medium variety', growing a variety such as *Nadine* may result in cadmium levels over the MPC. Potatoes which exceed the MPC cannot legally be sold in Australia.

For example, on a site where a medium accumulator like *Delaware* produced a tuber cadmium concentration of 0.080 mg/kg fresh weight, *Nadine* would, on average, be expected to produce a tuber cadmium concentration 38 per cent higher than *Delaware* which equates to a concentration of 0.110 mg/kg.

The good news is that early results show that the promising new varieties *Winter Gem*, *Riverina Russet* and *Passion* are all medium cadmium accumulators similar to *Coliban*. The ongoing cadmium testing of new varieties and promising crossbreds is a useful component of potato variety evaluation allowing industry to make informed decisions about the adoption of new varieties.

Acknowledgements

We thank APIC, HRDC and the Potato Growing Industry Trust Fund of WA for helping to fund this work.

The cadmium concentration in 12 potato varieties compared with Delaware

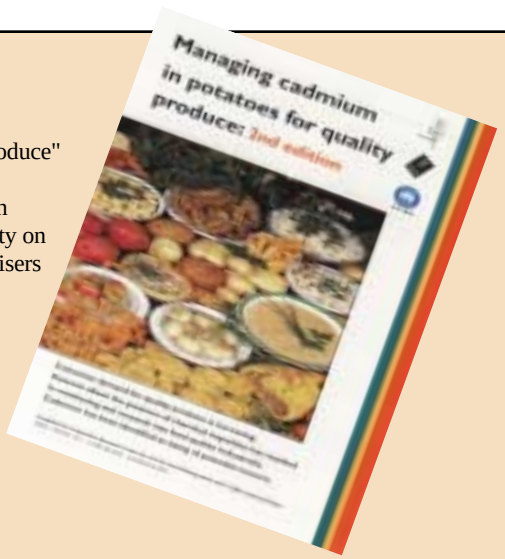
Variety or crossbred		Tuber cadmium as a percentage of *Delaware*	Number of sites where tested
	high cadmium		
92-27-2		148	1
Nadine		**138**	**4**
Kennebec		**125**	**5**
Ruby Lou		107	2
Wilwash		106	5
Mondial		103	3
Delaware		**100**	**7**
93-96-9		97	1
Winter Gem		93	2
Riverina Russet		89	1
Coliban		86	1
Passion	**low cadmium**	84	1
Nicola		61	2

Cadmium in potatoes

A second addition of the colour brochure "Managing cadmium in potatoes for quality produce" has been released by the CRC for Soil & Land Management in Adelaide.
The brochure contains updated information on revised maximum permitted concentration (MPC) for cadmium in potatoes, new information on the effects of irrigation water salinity on tuber cadmium, and recent information from the fertiliser industry on better quality fertilisers available for horticultural growers.

Copies are available from:
CRC for Soil & Land Management (08) 8303 8672
or the following state contact -

WA	**Allan McKay**	**(08) 9368 3820**
Vic	**Andrew Henderson**	**(03) 9210 3820**
Tas	**Leigh Sparrow**	**(03) 6336 5379**
NSW	**Stephen Wade**	**(03) 5883 1644**
QLD	**George Rayment**	**(07) 3896 9487**



Potato growers look to reclaimed water during dry spell

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Potato growers from the Torquay area are hoping to use re-cycled sewage as an alternative water source.

The growers approached the local water authority, Barwon Water, to see whether reclaimed water from Geelong's Black Rock Sewage Treatment Plant would be suitable for potato crops.

In response, Barwon Water commissioned scientists at Agriculture Victoria Knoxfield to conduct a feasibility field trial. The trial is being conducted in conjunction with the Environmental Protection Agency (EPA) with initial results expected in August this year.

Torquay growers Charlie and Silvia Scaffidi are keeping a close eye on the outcome of the re-cycled sewage water trial. The Scaffidis grow *Sequoia*, *Coliban* and *Desiree* potatoes on 20 hectares of land, but the long dry spell and unseasonal frosts have just about broken their resolve to keep going.

'We need water to be able to produce potatoes as a summer crop. A couple of years ago the prices were down but last year they were good, it's just we didn't have the yields. We had a November harvest, but we planted late because it was so dry and it's been the same this year,' Mr Scaffidi said.

Agriculture Victoria's Dr Robert Premier said; 'This is the first potato industry study in Australia to look at the nutrient impact on plants and levels of harmful pathogens in re-cycled sewage water. In Victoria we have strict guidelines for the use of reclaimed water in food crops. This trial will provide useful information for the industry on the suitability for using this water on a root crop like the potato.

The climate and conditions in the Torquay area make it ideal for the winter production of potatoes, filling a niche window in Victorian production, which predominantly relies on summer crops grown in cooler regions. A three year dry spell has made it hard for growers who have suffered from low yields and lower prices, as well as tougher competition from South Australian growers.

Barwon Water re-use officer Peter Byrnes said the authority had adopted a new reclaimed water policy which reflected a strong commitment to re-use of a valuable resource.

Barwon Water is already involved in a number of re-use ventures, including an extensive flower farm, a high profile vineyard and a commercial tree lot.

In the last 16 months Barwon Water supplied more than 1,000 million litres of disinfected reclaimed water to the flower farm from the Black Rock treatment plant which has recently undergone a major upgrade and is the largest of its kind in the world. The treatment process is state-of-the-art technology utilising a chemically free, natural biological process to remove pollutants and bacteria. The plant produces 55 million litres of high quality reclaimed water each day.

Recently Barwon Water joined forces with the State Government on a major re-use study. The Deputy Premier and the Minister for Agriculture and Resources, Mr Pat McNamara, has requested that the authority investigate the feasibility of establishing a 'green industry' region using reclaimed water from Black Rock.

The study will commence shortly and will look at commercial opportunities for the area around Black Rock and Torquay which can benefit from a secure supply of water.

For further information contact Dr Robert Premier at the Institute for Horticultural Development at Knoxfield on (03) 9210 9222. ■

Bruce Fry (left), Potato Extension Officer from Agriculture Victoria, takes a sample of water recycled for potato production

Saline irrigation water - an Australian perspective

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Growers need to review their irrigation management as the toxic effects of salt could be having a greater impact on their crop performance than they think.

Guidelines used in Australia for managing saline irrigation water have been developed in the USA and are based on waters that are generally low in chloride. According to these guidelines water is safe for potatoes at salinities below 700 mg/L TDS (700 ppm).

In Australia, chloride levels in saline irrigation water are high and economic damage may occur at salinities below 700 mg/L TDS. This is particularly so where low volumes of water are being applied often, which keeps the leaves moist over a longer period of time and allows more salt to enter the plant.

What is salinity and how does it affect potatoes

Water is described as saline when the concentration of dissolved salts is high enough to cause poor plant growth. In Australian potato production areas, salinity is usually associated with water in which sodium chloride is the main dissolved salt.

Salinity has two main effects on plant growth:

1) Increasing the concentration of salt dissolved in water makes it harder for the plant to take up water from the soil. This is called the droughting or osmotic effect of salinity and occurs without salts entering the plant. It is similar to the effect on plants caused by missing a few irrigations. All types of soluble salts cause this problem regardless of whether they are potentially toxic or not.

2) Some of the salts enter the plant and cause it to become sick. This effect is known as the toxic effect. In Australia, the most common toxic salt is sodium chloride.

The amount of toxic salts entering the plant increases as the concentration of salt increases in the water around the roots or on the leaves. Salt enters the plant much more readily through the leaves than the roots.

Plant tissue analysis (petioles) can detect the presence of toxic salts. The graph shows the levels of chloride corresponding to mild and severe poisoning of potato plants for dried leaf petioles sampled at different crop growth stages.

How much salt is too much

A decline in crop performance occurs above a certain level of water salinity and this is called the crop threshold to salinity.

If salinity is only exerting a droughting effect then the threshold at which problems begin is 704 mg/L TDS. This is the threshold that is generally applied to potatoes in Australia. For every 640 mg/L TDS increase above this, the crop loses about 12% of the yield (assuming no toxic effect from the salt).

Earlier we noted that toxins enter the plant more readily through the leaves. Where the irrigation system wets the leaves the threshold for chloride is between 177 and 354 mg of chloride/L.

This is a wide range. The amount of chloride taken up depends on the concentration of chloride in the water on the leaf and the length of time the leaf remains wet.

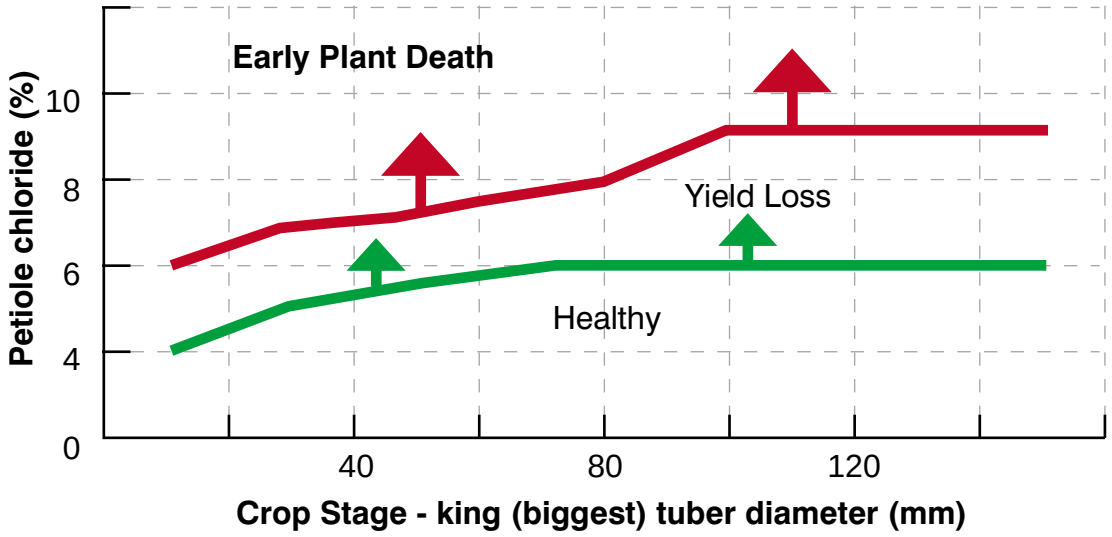
The concentration increases as water evaporates. This occurs while droplets are airborne on the way to the leaf and on the leaf surface.

Factors affecting rates of water evaporation and the length of time over which irrigation wets the leaves are:

- Weather - in regions with a dry semi-arid climate the rate of evaporation is higher than regions with a moist temperate climate. Evaporation rates are higher in the day than at night.
- Spraydrift, droplet size and wind - evaporation rates from small, drifting droplets are higher than from large droplets. Evaporation rates are higher in windy conditions.
- Irrigation application amount and frequency - increasing the irrigation application rate reduces the application time, and reducing the number of irrigations shortens the length of time over a season that a leaf is wet.

Many Australian potato crops are grown in summer on light soils and are irrigated frequently with small amounts of water. Under these conditions the lower threshold for chloride is applicable (177 mg of chloride/L). This means that potato growth will be slowed by the toxic effect of the salt before it reaches the threshold for the droughting effect (704 mg/L TDS).

In practice, **losses due to the toxic effect may begin at a salinity of 500 mg/L TDS.**



Levels of chloride corresponding to the beginning of yield loss and the beginning of plant death for dried potato leaf petioles sampled at different crop growth stages.

Emerging salinity problem

Recently, in both South Australia and Western Australia, high chloride levels have been observed in leaf petiole samples from poor potato crops. The crops have been grown with over-canopy sprinklers producing small droplets and where small amounts of irrigation (about 4 mm per application) have been applied often (1 or 2 times per day). This problem has been noticed more often with centre pivots. The source of the problem is not the pivot *per se*, but rather it is a combination of water quality, the sprinkler package and pivot management (rate of rotation).

Damage has been observed at water salinities as low as 500 - 600 mg/L TDS. In these cases chloride levels have been as high as 12% in dry leaf petiole samples, even though tests of soil salinity have proven low to moderate.

Recent changes in irrigation frequency and application rates are thought to be increasing the uptake of chloride by the plant. Across the industry, irrigation frequency has increased in response to expansion into areas with lighter soils, widespread uptake of *Russet Burbank* (a variety which is highly sensitive to water stress) and the availability of systems capable of irrigating more than once a day.

Practical strategies to reduce loss

Making as many of the following changes as possible can reduce leaf chloride:

- Irrigate at night, or if not practical, in the cooler, more humid part of the day. (This also affects leaf disease control strategies.)
- Increase the application rate and reduce the frequency of irrigation - provided soil infiltration rate is not exceeded.
- Irrigate during periods when wind speed is low and use sprinklers that produce larger droplets - both changes reduce wind drift.
- Avoid adding other sources of chloride to the crop. For instance use a potassium source other than muriate of potash.
- Favour early maturing varieties - more of their growth occurs whilst weather is temperate and moist and they accumulate less chloride over the shorter growing season.
- If more than one source of water is available, use the least saline for long season varieties such as *Russet Burbank*.

In other crops, for example grapes, research has shown that some varieties have low rates of chloride uptake by the leaves. Use of these varieties reduces plant chloride. Before this strategy can be applied to potatoes, the varieties with low chloride uptake through the leaves will need to be identified. ■

Measurements of salinity

Salinity is commonly expressed as the total dissolved solids (TDS). This is measured by weighing the salt remaining after the water has been evaporated and is reported as mg/L TDS (milligrams of total dissolved solids per litre of water).

Alternatively, salinity can be expressed as the conductivity of electricity through water and this is proportional to the concentration of dissolved salts. A measurement of the water's electrical conductivity is known as an EC measurement and is often reported as dS/m (deciSiemens per metre) or mS/m (milliSiemens per metre). These measures are used as a guide to the droughting (osmotic) effect of salinity and are not a guide to the toxic effect.

Divide a measurement of TDS in mg/L by 640 to convert the measurement to EC in dS/m. Measuring the EC of water is both faster and cheaper than weighing the dissolved salts.

The toxic effect of salinity is proportional to the concentration of the particular toxin in water. These measurements are reported as a weight of toxin per litre, for example mg of chloride/L.

Other conversion factors

1 mg/l TDS = 1ppm
1 dS/m = 1000 µS/cm
1 dS/m = 100 mS/m

Cover crop/green manure contributions to soil fertility

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The objective of this study was to investigate the benefits of a range of cover crop/green manures in increasing phosphorus availability in the soil to the following potato crop.

Of particular interest was the performance of white lupin on the iron rich, high phosphorus fixing, basalt derived soils of the Robertson district which are also common to many potato growing districts in Australia.

(Phosphourus fixing/fixation involves the conversion of phosphorus into forms that cannot be used by the plant)

This study was a major component of the project *Sustainable Potato Production in Highland Areas of NSW*, which was completed in 1999.

How can lupins increase the amount of phosphorus available in the soil

White lupins (*Lupinus albus*) secrete organic acids from specialised roots termed "proteoid roots". These organic acids release phosphorus which is locked up in the soil, making it available to the lupin plant. When the lupins are incorporated back into the soil, the phosphorus should become available for future crops.

The study

The study commenced in February '98 and concluded after harvest of the potato crop in February '99. The study was carried out at a field site on property managed by the Donovan brothers 7km south west of Robertson in the NSW Southern Highlands. The paddock used for the experiments had been cropped with potatoes for the previous two years. Oats are the traditional green manure crop in the area.

The five cover crop treatments investigated were bare soil, oats, rangi rape, white lupin and white lupin in combination with rangi rape.

It was proposed that the cover crop consisting of 50% white lupin and 50% rangi rape (sowing rate: 100kg/ha lupin + 3kg/ha rangi rape) would have greater total organic matter and total phosphorus than single species cover crops of oats, rangi rape and white lupin. This is due to an interaction between the two species whereby the root system of the rangi rape benefits from the phosphorus released by the white lupin.

The incorporation of the combination cover crop/green manure into the soil and its subsequent breakdown prior to the sowing of the following potato crop was expected to result in a greater increase in soil available phosphorus compared with the single species cover crops.

Results

- Both rangi alone and the combination cover crop produced approximately twice the organic matter of the oats and five times that of the pure lupin treatment.
- The total phosphorus per hectare incorporated in the rangi and combination cover crops material was equivalent to approximately 30kg of phosphorus per hectare.
- The incorporation of the cover crops did **not** result in increased available phosphorus in the soil **prior** to sowing of the potato crop.
- Further soil testing 6-8 weeks **after** planting showed that when fertiliser was applied, the combination and lupin treatments had significantly higher levels of available phosphorus than the rangi, oats and bare soil treatments.
- The yield and phosphorus nutrition of the potato crop was **not** improved by any of the cover crop treatments

In other words while the combination cover crop did in fact accumulate more phosphorus than the oats, it did not result in improved yields of the potato crop.

We think this is because the level of available phosphorus in the soil was already quite high at the beginning of the study. High levels of available phosphorus restrict the development of the organic acid secreting proteoid roots by white lupin.

Donovan Brothers' farm near Robertson, Southern Highlands, NSW

Other benefits of cover crops/green manures

The benefits of a white lupin - rangi rape combination go beyond the potential for increased phosphorus availability.

A white lupin-rape combination cover crop provides soil protection and can contribute to soil structural improvement by roots binding soil together and through organic matter addition.

As lupins are a legume, they can also improve soil nitrogen providing that the seeds are inoculated with compatible rhizobia before sowing.

Fungal and pest cycles can also be broken by the biofumigation provided by the rape component of a combination cover crop. Incidences and severity of *Rhizoctonia* were significantly reduced by the presence of rape plants compared to the pure oats and pure lupin cover crops.

Implications

The combination of rape and a proteoid root producing lupin variety (eg. *Lupinus albus, L. consentinii*) has the potential to provide benefits not only on high phosphorus fixing soils but also on soils that have been run down by long cropping histories or between pasture and cropping phases in a paddock rotation.

Most phosphorus fixation occurs during the pasture phase of a crop rotation, resulting in a decline in soil available phosphorus. Because of the low phosphorus status of the soil after a pasture phase, the combination cover crop has the potential to release greater amounts of phosphorus, due to greater proteoid root development by the white lupin component.

The use of a fodder variety of white lupin to withstand grazing pressure, variations in the ratio of lupin plants to rangi plants in the combination, and the interaction of white lupin in other cover crop mixtures could also be examined.

Acknowledgments

The project was funded by HRDC, APIC, RDPA&LA, DDPG&LG, Guyra Potato Growers, Wingecarribee Shire Council and Sydney Water. The project was co-ordinated by Sandra Lanz of LANZ Agricultural Consulting. The Phosphorus Management component was undertaken as an Honours project through the Geography Dept. of the Australian National University with academic supervision and technical support provided by Dr. Richard Greene (ANU) and Dr. Peter Hocking (CSIRO Plant Industry). Many thanks go to Trevor, Barry and the late Snow Donovan for their advice and assistance in conducting the field trial. ■

The effect of lime on soil acidity and common scab incidence in sandy soil

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Soil used for potato production can be quite acid particularly some of the sand hill soils used around Narrandera and Finley (NSW) where the pH can be as low as 4.0.

Whilst potatoes can grow quite well at such a low pH, other crops in the rotation prefer a higher pH. Growers are concerned that raising the pH to benefit the other crops in the rotation may increase the incidence of common scab on potatoes.

This project aims to examine the effect of applying lime on soil acidity and how this affects common scab.

In trials being undertaken at Narrandera, Robertson, and Blayney (all in NSW) different rates of lime (0, 2.5, 5.0, 7.5, and 10 t/ha) have been applied either just before the rotation crops or just before the potato crops are planted. Results to date have not shown any increase in scab at any of the trial sites.

In the table below, the pH changes and associated potato yield for the potato crop are shown for the Narrandera trial. The soil at this site was a typical red sand common to the sand hills along the Murrumbidgee River.

These results were for two different blocks of 10 metres by 4 beds wide on the same farm. One trial plot was sown in February and harvested in June and the other sown in August and harvested in December. In both cases lime was applied just before planting. Yield was higher in the limed plots in the December harvested trial, however the difference was not significant.

This project is continuing.

Acknowledgements

This work is part of a project 'Amelioration of Acid Soils used for Potato Crop Rotations' which has been funded by Acid Soil Action (NSW). ■

Lime	June Harvest		December Harvest	
(t/ha)	Yield (t/ha)	pH	Yield (t/ha)	pH
0	57	5.0	58	4.1
2.5	56	6.1	63	5.0
5.0	58	6.2	64	5.1
7.5	54	6.3	63	5.4
10.0	54	6.4	64	5.5

pH was measured in calcium chloride.

Control of black nightshade

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Wherever potatoes are being grown, current weed management practices tend to provide control of most weeds except nightshade.

With each new planting of potatoes in a paddock the number of nightshade plants is likely to be increased, as available herbicides and other cultural practices do not provide adequate control of this weed. In a short time a few nightshade plants can become a very dense crop.

Serve-Ag Research have been conducting work over the past three years to seek solutions to the increasing nightshade problem in potatoes. A number of trials have been conducted in potato growing areas throughout Australia, with some very encouraging results.

Currently, most herbicides used for broadleaf weed control in potatoes are related, belonging to resistance group C. These products (eg metribuzin) provide limited control of nightshade, and without rotation with other types of herbicides, the likelihood of increasing resistance of a number of weeds to these products is of concern.

The current project has identified three new herbicides that have shown potential. None of these belong to herbicide group C. Results from a large number of trials have been very good for both control of nightshade and safety on the potatoes.

The process of registering the new chemicals with the National Registration Authority is currently underway. The first product is expected to be commercially available within a couple of months. This will be a major achievement as the average age of broadleaf herbicides registered in potatoes is 41 years.

In the final stages of the project, the focus has been on integrating any new herbicides with the current commercial practises. Cultural and herbicide strategies differ considerably around the country. Every effort is being made to address the needs in these different regions.

This project has been recently completed and a final report will be available shortly.

Acknowledgements

Funding was provided by the HRDC, APIC, FMC, BASF, AgrEvo, DuPont, Rhone-Poulenc, Cyanamid and Novartis.

■

Better soil and water management on sandy soils in South Australia

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Results from field trials in the south east of South Australia support further adoption of under-ripping, wide beds and clay spreading practices for potato production on sandy soils.

The trials have shown that under-ripping potato beds in compacted sandy soils reduces soil strength, enabling better root growth and increasing the yield of saleable tubers. Wide beds improve water retention as compared to single ridges through improved infiltration and reduced evaporation. Incorporation of clay looks a promising soil treatment, although longer term trials are needed to determine the full impact on soil and water status.

The combined effect of these practices has the potential to reduce irrigation volumes and frequency on sandy soils.

Why do we need to improve practices

The expansion of potato production in recent years has been onto light textured sandy soils, away from more traditional loams. This expansion has identified problems with soil physical properties and irrigation management on these sandy soils.

The sandy soils in south east South Australia typically consist of non-wetting topsoil, a compacted and bleached soil below the surface layer and a poorly drained subsoil. These features restrict root development and as a consequence water is not readily available to plants. These combined factors reduce quality and yield of potatoes. Frequent irrigations are required to maintain adequate soil moisture.

A three-year project is under way investigating soil and water management strategies to improve productivity and water use efficiency.

Initial trial results

A pilot trial in 1996-97 and two trials in 1997-98 assessed the potential of alternative soil treatments such as wide mound beds instead of traditional ridges, under-ripping beds post planting, applying various mulch treatments and the application of clay.

Under ripping reduced soil compaction, while wide beds and straw mulch reduced temperature fluctuations and maintained higher moisture levels. This resulted in higher yields in ripped and wide bed treatments. The addition of clay to reduce the effects of the non-wetting soil did not produce higher yields, possibly due to its poor incorporation.

1998-99 trials

A second season of field trials was established in September 1998, to confirm and build on these initial results. The aim has been to draw links between soil moisture status, yields and alternative soil treatments.

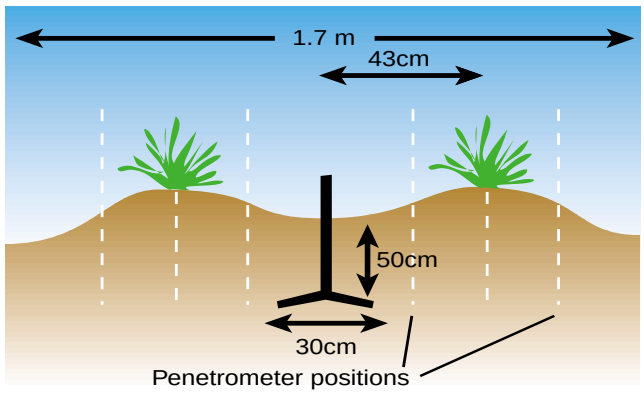
Two sites were used to examine the effects of under-ripping, addition of clay and bed structure on soil moisture, temperature, soil compaction, root growth, and the size and saleable yield of potatoes. Mulches were not trialed this year because in the initial trials, they caused harvest problems.

Western Flat trial

This trial compared ripped and non-ripped treatments in a centre pivot irrigated crop of *Shepody*. Clay incorporation and 1.7m wide beds (two single ridges rolled flat) are standard practice at this site. Three weeks after planting, beds were under-ripped with a single 30 cm wide 'batswing' tine, at approximately 50 cm depth, down the middle of the bed.

Callendale trial

Combinations of ripped/non-ripped, wide beds/ridges and clay/no clay treatments were compared in a crop of *Russet Burbank*. Clay was spread at 160 t/ha and incorporated during normal pre-planting cultivation. Ripping, as above, was carried out 2.5 weeks after planting.



Wide bed dimensions and ripping location

Effects of ripping

Under-ripping significantly reduced soil compaction with the greatest effect being close to the rip line. Soil compaction on the outer edge of the bed was reduced, but to a lesser extent. A greater benefit from ripping could possibly be obtained by running the implement (two per bed) along closer to the line of potatoes, thereby providing the maximum effect directly under the plants.

At Western Flat, soil compaction generally increased through the season, but ripping prevented the soil becoming compacted to a point where root growth would be strongly impeded in the top soil. In non-ripped beds the soil compacted to a point that virtually prevented root growth.

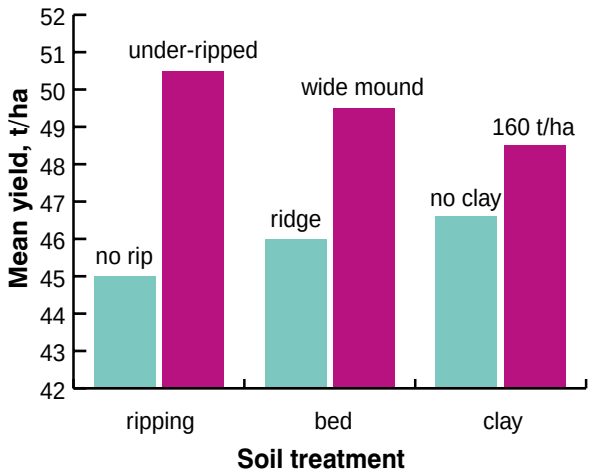
At the Callendale site, under-ripping clearly enhanced root growth where root density in the topsoil was 45% higher than in non-ripped treatments.

There was higher soil moisture in non-ripped treatments which may indicate that soil water flow from the top soil is improved in ripped beds, and also that the greater number of roots are likely to be drawing out more moisture.

The effects of ripping increased yield at both trial sites. At Western Flat, ripping resulted in a 5% increase in 'saleable' yield of potatoes (tubers over 100g). This was due to a slightly higher total yield, combined with a 24% reduction in the proportion of 'smalls' (tubers less than100g).

There were similar results at Callendale, where ripping significantly increased yield and reduced 'smalls' in all four combinations of clay and bed treatments. The greatest yield increase (7.2 t/ha) was with the ridges and no clay treatment.

Additional ripping trials on growers' properties across the south east of South Australia organised by Safries' agronomist, Paul Frost, have provided results consistent with the trial sites. Generally, reports have been of yield increases of 5-6%.



Effects of soil management on yield (>100g tubers) of Russet Burbank

Wide beds improve moisture retention

Soil moisture readings taken throughout the season at Callendale indicated moisture was consistently higher in wide bed treatments compared to single ridges. During the peak water use period from December to late February (40 to 120 days after planting), the available water measured in the root zone (0-30 cm depth) one day after an irrigation was 11.4 mm in wide beds compared to 4.5 mm in ridges. With field capacity (maximum amount the soil can hold) at 24 mm, this means that just one day after irrigating, 80% of the water stored in the soil after irrigating had been depleted in the ridge system, compared with only 50% in wide beds. These higher moisture levels in wide beds are most likely due to better infiltration, less run-off and also reduced evaporation.

The use of wide beds on sandy soils improves the retention of readily available water during the period of peak water use and as a consequence it should be possible to reduce irrigation quantities, and/or increase the time between irrigations. This would lead to greater water use efficiency.

Wide beds produced higher yields. This is most likely due to increased soil moisture availability. The greatest effect was seen in the non-clay treatments, with an average 5.5 t/ha increase.

Incorporation of clay

Incorporation of clay at 160 t/ha increased yield but not significantly. The benefit of clay was seen in ridge treatments, where yields were 4 t/ha higher. Root density was higher in the top soil of clay treatments. Clay in combination with wide beds did not increase yield.

Soil moisture was actually lower in clay treatments. This may be due to the absorption of moisture by clay lumps, away from the surrounding sand. The moisture and nutrients though, would still be available to plant roots growing into the clay.

Clay incorporation is becoming a standard practice on sandy soils. The full benefits of clay spreading in conjunction with irrigation are not immediate and several years of clay incorporation (as practised at Western Flat) may be necessary before the desired results are achieved.

Further work

In the final year of this project we are planning to:

- develop indicators for the selection of soils likely to benefit from these treatments
- expand trial sites to cover a broader range of sandy soils
- focus more on irrigation management, using soil moisture devices and weather data to improve water use efficiency
- conduct a field day and demonstrations of moisture monitoring tools, ripping and penetrometer equipment.

Acknowledgements

This project is being funded by the HRDC and is being conducted by PIRSA Rural Solutions, with technical support from Safries Pty Ltd. We thank trial site growers Trevor and Mark Pridham, and Forrest and Ross Young for their continued involvement.

■

Bob Peake downloading weather information at the site

Improving phosphorus efficiency on red soils

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Krasnozems are important soils for potato production, however they have a high phosphorus fixing capacity which reduces the efficiency of phosphorus fertilisers.

Even when fertilisers are banded 5-10 times more phosphorus is applied than is removed in the tubers. Since fertiliser costs will continue to rise, we need to look at whether there are better ways of applying phosphorus to reduce the cost to growers

The project aims to identify and evaluate new, more efficient ways of applying phosphorus fertiliser to potatoes on krasozem soils. Small amounts of phosphorus and nitrogen fertilisers placed closed to the seed, known as starter fertilisers, have shown improved yields with small seeded crops but have not yet been tried with potatoes.

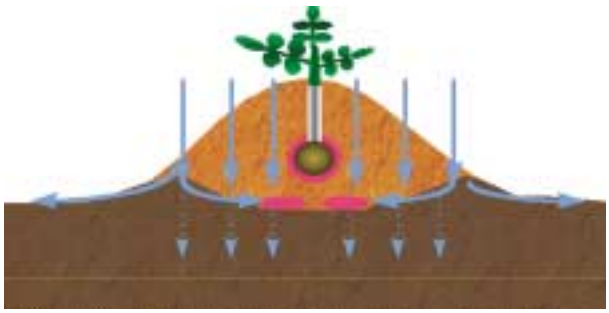
Two field trials comparing five phosphorus starter fertiliser rates up to 80 kg P/ha against five conventional banding rates up to 240 kg P/ha have been completed. Starter fertilisers were placed as a band of MAP just over the top of the set. Excavations of potato plants prior to emergence indicated the first roots emerge radially around the base of the stem, then grow around the surface of the set before turning downwards. Subsequent roots emerge from nodes further up the stem and tend to grow more horizontally. The most effective placement for starter fertilisers would be in the soil immediately surrounding the set.

The development of early roots on potatoes, from left to right 11 days after planting, 18 days after planting 20 days after planting

In both field trials there was an early response to starter phosphorus in leaf development and phosphorus concentration but there was no effect on total tuber yield or marketable yield. However it did cause a small increase in the incidence of tubers showing signs of water stress such as narrowing in the centre and secondary growth. The absence of any tuber yield response suggests there may be factors preventing the uptake of starter phosphorus later in the season.

This might be related to the changes in moisture distribution in the mound as the season progresses.

The development of the potato crop affects the distribution of soil water during the growing season. Water is diverted by leaf canopies into the furrows, and roots remove water from within the hills. It is likely that water diverted by potato canopies into furrows flows sideways into the base of hills.



(Above) Early in the season before canopy development, water drains through the hill to firmer sub soil

(right) After the canopy has matured, water is shed off the canopy into the furrows where the sideways flow can bring the water back to the main fertiliser bands

Phosphorus uptake is highly dependent on soil moisture and occurs only in the immediate vicinity of the fertiliser band. The redistribution of soil moisture to the base of hills later in the season, enables continued phosphorus uptake from the main band region, but reduces the amount of water reaching the starter band area.

If a starter fertiliser is to be effective a great proportion of the applied phosphorus must be used by the potato within the first two months, otherwise the soil close to the set becomes too dry for effective phosphorus uptake.

This coming season's work will investigate ways of achieving better usage of the starter phosphorus early in the season. We will try placing the starter fertiliser in the soil surrounding the set using both granular and liquid fertiliser. In addition soil moisture in the mound will be increased by a combination of earlier irrigation and slight compression of the soil around the set to improve the soil's water holding capacity.

Acknowledgements

The work is funded by HRDC, Impact and Pivot. We also appreciate the help given by Dale Speight of Paloona for providing the trial site and assisting with growing the crop.

■

National Conference - Potatoes 2000

"Linking Research to Practice"

DR CHRIS WILLIAMS
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Potatoes 2000 - the potato industry's national research, development and technology transfer conference will be held in Adelaide from 31 July to 2 August 2000 at the Stamford Grand Hotel, Glenelg.

It has been a long time between national conferences with the last one being in Tasmania in 1993.

Purpose of conference

The purpose of the conference will be to bring people up to date with the latest research and development activities, provide a forum for debate about issues important for industry development and to identify issues important in facilitating technology adoption within the industry.

Key topic areas to be addressed will include plant improvement, plant-protection, plant nutrition, crop agronomy and sustainable systems, machinery, handling systems and transport, product quality, storage and marketing.

The conference will be an excellent forum for all those interested in the advancement of the Australian potato industry through the research, development and adoption of technology.

Delegates will include researchers, advisers, growers, processors, merchants and those people involved in a wide range of agribusinesses.

Structure and program

The conference will run over three days with post conference tours offered on day four to South Australian growing areas and facilities. The program includes a mixture of talks by Australian and overseas speakers, workshops on key challenges facing the industry and a major trade and technology exhibition.

It will provide an opportunity for participants to network, hear about the results from the latest research and development, and allow participants to raise and discuss issues of concern that can influence future research.

Topics will cover all aspects of potato production and marketing. A detailed program is currently being finalised and will be available before Christmas.

Location and venue

The conference venue, the Stamford Grand Hotel overlooks Adelaide's most popular suburban beach at Glenelg and is only a 30 minute tram journey from the city or a 15 minute drive from the airport.

The hotel will provide excellent conference facilities for the sessions and the trade exhibition. Accommodation at special conference rates will be available for delegates. Glenelg has a range of accommodation to suit every budget, from four star motels to comfortable cabins in caravan parks.

Cost and registration

Registration fee will be approximately $A320 including most meals. For those interested in attending a registration form will be sent out with the December edition of *Eyes on Potatoes*.

Want to know more

As well as the organising committee, there are co-ordinators in each state that you can talk to about the conference. If you have any ideas or wish to know more about the conference please do not hesitate to contact one of these people.

The conference has been made possible with the support from HRDC and the Potato Levy. ■

Advanced research complex

Glasshouse potato trial

Field trials

Adoption of new technology

July 31st
August 2, 2000
Put it in your diary before you forget!

Organising Committee

Chris Williams (SARDI – Research)
Leigh Walters – (Technology Transfer)
Neil Perry – (PGSA – Grower)
Wayne Cornish (PGSA - Grower)
Norbert Maier (SARDI - Research)
Peter Alexander (Smiths - Processor)
Derek Cameron (IAMA - Agribusiness)

State Coordinators

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Mark Hickey – (02) 6951 2523

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Russell Sully – (03) 9210 9222
Tony Myers – (03) 5622 2227

Western Australia
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Peter Dawson – (08) 9892 8444

For all details relating to the Call for Papers, sponsorship or the trade exhibition, contact

Potatoes 2000 Conference Secretariat
PO Box 6129 Halifax Street
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Potato agronomy: study tour to UK and USA

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During a recent study tour of potato agronomy in the UK and USA I have obtained information on new varieties, new systems for washing potatoes (using plastic water slides), making compost in bulk on farms and use of a chlorophyll meter for nitrogen management.

I have also made many new contacts, increasing the opportunities for information exchange between Australia and the UK and the US.

The following are some recommendations from the study tour.

1. New varieties

Certain new overseas bred potato varieties should be imported, including *Charlotte* and *German Butterball* (cocktail market), *Norika* (crisps), *dark red Norland* (red skinned) and *Century Russet* (fresh), through the NaPIES program.

Packaging potatoes into punnets in Cornwall

2. Cocktail or punnet potatoes

A potential export and domestic market exists for small, cocktail potatoes (10 to 30 gram tubers) of salad varieties such as *Charlotte* and *German Butterball*. Returns up to $A750 per tonne were paid to UK growers for 10 to 30 gram tubers. Such potatoes are sold in punnets, pre-washed - ready to be cooked and often put whole in salads. They must look attractive. Work is needed on such factors as: plant spacing, varieties and tuber set to enable the full economic potential to be achieved.

Intake into water slide

Water slide with chlorine and food detergent

Final product. (The cultivar is California Long White)

3. Need for independent variety trials

In the UK there is a law that a given potato variety must be tested by an independent agency for a minimum of two years at two sites per year before a variety can be placed on the national lists, sold as certified seed and traded in commerce in the UK. The idea is that it is essential to test varieties from a wide range of sources in the same trials together, under the same soil, site, crop management, disease and environmental influences to provide unbiased information to growers to select varieties for profitable production.

4. Water slide method to wash potatoes

The Australian potato industry should consider use of the Californian water slide plus detergent method to wash potatoes faster and to reduce damage, combined with chlorination of recycled water to reduce *Erwinia* soft rot in washed packs of potatoes.

5. Chlorophyll meter for nitrogen management

Research work in the USA by Dr Vitosh showed a strong correlation between leaf chlorophyll and leaf nitrogen content. This meter has good potential to be a tool to fine tune nitrogen management to field conditions for potatoes and a range of vegetable crops. ■

Further information on the study tour can be obtained by purchasing: 'Report of a study tour to England and USA on potato and vegetable agronomy' by C. Williams. It contains 11 colour plates within the 66-page report. Copies can be obtained by forwarding a cheque for $12 per copy to SARDI office, Lenswood Centre, Swamp Road, Lenswood, SA 5240.

Sale by dimension for certified seed

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The Victorian Certified Seed Potato Growers Committee (VCSPGC) has announced that from January 2000 Victorian certified seed will only be described and sold by dimension in millimetres.

The current practice of description of seed lines by tuber weight limits will be discontinued after this season. Certified seed will in future be sorted for sale by dimension in millimetres and more particularly by whether it will pass through a square hole of specific internal dimension.

What this means in practice is that a 35 to 110 gram seed sample will instead be referred to as a 35 to 55 millimetre sample. All the tubers in the sample will be too big to pass through a 35 mm hole but small enough to pass through a 55 mm hole.

The normal certified seed limits of 35 to 250 gram will be discontinued and replaced by a dimensional limit of 35 to 75 mm. For some lines of seed this may mean a marginally smaller sample, while for others, particularly those with low dry matter or elongated tubers, the sample may be slightly larger.

At present the Victorian seed industry is communicating with buyer groups throughout the industry to obtain feedback on what dimensions in millimetre most closely match the old weight category sizes. The results of this research will be publicised over the next few months as they become available.

Different varieties, particularly those with elongated tuber shapes may give different sample sizes when run through the same size screen. Consultation with seed buyers is important to ensure they receive the sample size they require under the new description. Seed growers will also need to know that they are supplying the size range that their customers require.

The VCSPGC has decided to make this major change in the method of seed description because many more buyers in all seed buying sectors are now using description in millimetres. Our use of weight sizing has also caused some confusion in overseas markets in the past. Certified seed schemes in other countries all use sizing in millimetres.

The VCSPGC has prepared and circulated throughout the industry, a standard plastic template for grading by dimension. This template will be the standard used to clarify exactly what size, hole shape and internal dimension is being used. Templates are available from the Victorian seed industry. ■

Seed sizing template adopted as the 'standard' by the Victorian seed industry

Warragul potato grower, Gordon Jones, checking some freshly dug Wilwash for size prior to grading

National seed potato standards

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Last year the Australian Potato Industry Council commissioned a project aimed at establishing greater uniformity within the seed potato industry.

The first stage of the project was to investigate the need for national seed potato certification standards. The consultants found that such standards would benefit the industry by providing higher quality seed, by better specification of the product being sold, by facilitating interstate movement of early generation seed and developing our export markets by more closely meeting quarantine requirements of overseas customers, while at the same time having enhanced credibility as the National Scheme.

The project has confirmed that there are real benefits to the industry if all the seed production schemes are using the same language and terminology to describe seed potatoes.

In early June a meeting of potato industry representatives from around Australia at Knoxfield Victoria agreed on the following points.

- there should be a national uniform system for describing seed potatoes
- there needs to be a mechanism for coordinating the schemes across Australia
- any generation of seed should be able to be certified and sold as certified seed
- the national system should facilitate different quality seed to be differentiated independent of generation.

This National Seed Potato Standards system will simplify the trading of seed across Australia and facilitate exports.

One of the other key benefits will be the ability of growers to select from a wider range of seed quality to obtain seed which is best suited to the market potatoes are being grown for (i.e. washed, crisping, brushed and French fry).

Once the standards have been ratified by the industry the project will then proceed to Stage 3. During this stage development of the National Standards Manual will be completed before proceeding with the final stage, Stage 4, which is a communication program aimed at informing all sectors of the industry how to work with the national standards.

The Expert Foundation's, Dr Rob Brown and Dr Tony Kellock are conducting the project. ■

Reduced chemical usage in seed potatoes

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The certified seed potato industry has expressed interest in lessening the chemical load that it places on the environment and in leading the way for ware and processing potato producers to provide the market with a cleaner, greener and more sustainably produced product.

Currently the seed-potato industry uses chemicals to:

1) prematurely kill vines, thus ensuring optimum seed tuber size
2) to control pests, diseases and weeds
3) to meet quality control standards, e.g. treating tuber surfaces with various fungicides

This project demonstrated the suitability of currently available technologies, which utilise simple electromagnetic radiation (EMR) at ultra violet (UV) or infra-red (IR) wavelengths, to augment or replace some of the chemicals used in seed potato production.

Suitability of EMR for seed-potato surface disinfestation

In the past seed potato producers have relied on a range of toxic chemicals (Moncerene, formaldehyde and mercury-based dips) to reduce the amount of disease causing organisms that might be exported with their crop.

In the future better treatments may become available (see HRDC project - "*New chemical treatments for seed potatoes*" on page 14) but many of these still rely on water based carriers. Applied as a dip or mist, conventional treatments leave tubers wet and vulnerable to the very diseases that their application is meant to control.

Exposure to certain EMR can theoretically be used as an alternative to the chemicals used to reduce pathogen loads and would eliminate the problem of packing and storing wet tubers.

Infra-red (IR) and ultra-violet (UV) irradiation technology is presently used by a diverse range of industries (food processing, mining, nursery, pharmaceutical and stock feed production) where it is generally used for drying, roasting, cooking, sterilisation and insect disinfestation.

Surface disinfection of potato tubers with EMR could benefit the seed, ware and processing industries as it should protect against storage diseases, can easily be placed onto a grading line, leaves no residue and hence has no withholding period.

In this project tubers of the cultivar *Granola* were exposed to IR emitters fitted inside a continuous flow processor, known as a Rotiniser. Unfortunately, even on the lowest settings, the machine's internal surfaces heated beyond the point at which tubers suffered extensive heat damage when they contacted its walls. The Rotiniser's inability to finely control and dissipate internally generated heat makes it unsuitable for disinfesting tuber surfaces.

Previously the Rotiniser has been used to roast coffee and nuts, disinfest grain and kill a range of seeds but it would need extensive modification to make it useful for the seed potato industry.

A batch processing machine, designed and built by Mr Dirk Cortesi (the same engineer that designed the Rotiniser) was fitted with UV lamps and *Granola* tubers were irradiated for various lengths of time.

Patents for this machine have not yet been secured by its designer so unfortunately I was unable to personally view it or conduct a trial, however a preliminary trial conducted by Mr Cortesi shows that tubers given long exposures suffered severe sprouting inhibition but that the tuber tissue did not suffer the breakdown that occurred with the IR machine.

In another run, the number of tubers included in the batch was increased and this had less of an inhibitory effect. This means how tubers are packed into the device appears to effect exposure and hence sprout inhibition.

More work with the UV machine needs to be done to lessen the effects of sprout inhibition if it is to be used by the seed potato industry and also to test if surface disinfection is as effective as chemical treatments. The batch processor used for the UV trial was not as convenient as the continuous flow Rotiniser but I have been assured that a similar device could be constructed.

The sprout inhibition and supposed surface disinfection effect of UV exposure could be utilised by the fresh market and processing industries to increase storage life of potato tubers. I would therefore recommend that once the patent issues have been resolved, further independent testing of the UV machine is undertaken. In the meantime Mr Cortesi is willing to conduct more trials on potatoes.

In the past even shorter wavelength (X-ray and gamma-ray) radiation have been tested for this purpose but such energetic radiation sources represent a hazard for plant operators. They are also unacceptable to a significant section of the market because of largely unfounded health consequences. UV and IR radiation, which involve much lower energy levels, are considered to be much safer treatments.

Steam haulm and weed destruction in seed - potato crops

Seed potato growers must be able to control the size of the tubers produced and weed establishment within their crop. By killing potato vines before maturity the plant is forced to set smaller tubers. To achieve both haulm and weed destruction conventional production systems rely on a chemical desiccant spray containing Diquat.

At present Reglone® is the only herbicide registered for this purpose, so it is important for the industry to find alternatives, especially ones that are environmentally friendly.

Thermal defoliation systems are claimed to have multiple advantages over chemical systems in that insects, disease causing organisms, and weeds are simultaneously destroyed and are unlikely to ever develop resistance.

Thermal haulm and weed destruction using direct flame is used by Boral Energy in Tasmania and by Drackendon Agriculture in the UK. Boral Energy, in conjunction with Grapac, have also developed a steam weeder for use in orchards and vineyards. This system, called the Atarus, was considered to be less of a fire risk than the flame burner and was investigated for its suitability to seed-potato production systems.

Bob Smith of Garpac Pty Ltd ignites the Atarus Steam Top Killer

In the Atarus configuration tested and shown in the photo, water is vaporised in the exhaust gasses of a propane burner. Superheated steam (400ºC) is injected into the crop's canopy and is trapped there by an insulated blanket which trails behind the tractor-mounted burner array. This innovative design not only uses direct heat to kill plant tops but also takes advantage of the heat released as the water recondenses.

When tested on crops at Crookwell, in the Southern Highlands of NSW, the Atarus proved effective even when weather conditions would have made spraying impossible (i.e. during wind and rain). The concept machine used for this trial killed both haulm and weeds and was as effective as the Reglone treatment. There was no discernible difference in tuber quality or disease incidence (none was found) between the steam killed treatment and Reglone treatment.

Further work will be needed to adapt the Atarus system to make it competitive with conventional treatments. Issues such as the low ground speed (1km/h) and fuel costs need to be investigated before this system can be commercialised and further funding will be sought to develop the system. Accurate monitoring of pests and diseases over many seasons will need to be conducted to validate claims of its ability to depress pest, disease and weed pressures.

For further information on the equipment described in this article contact the following people:

Rotiniser	Bellaroma Coffee, 75 Kenneth Rd, Manlyvale 2093. Contact Tony Martin **(02) 99480221**
UV machine	Isetroc Pty Ltd, 19 McIllwraith St, Wetherall Park NSW 2164. Contact Domineco Cortesi **(02) 99489970**
Atarus	Boral Energy, 1/289 Canberra Ave Fyshwick ACT 2609. Contact Ian Johnstone **(02) 62392661.**
	Garpac P/L, 50 Leyland St Penrith NSW 2750. Contact Bob Smith **0408487486.**

Acknowledgements

This project has been was made possible with the assistance and co-operation of Crookwell Potato Association and HRDC.

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Cut seed in the tropics can work

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A window of opportunity exists for Australian seed growers to export seed to South East Asia by promoting the use of cut seed rather than planting small round seed as preferred by most South East Asian potato growers.

Despite South East Asian growers repeatedly stating that they prefer small round seed, there are indications that growers in some areas may be prepared to purchase larger seed and cut it, provided the seed is of high quality.

This may prove feasible because the high cost of seed in South East Asia is forcing growers to find avenues to extend the value of their seed. In some areas there is already widespread use of cut seed. Growers in Chiang Mai (Thailand) for instance, have been able to reduce seed requirements from around 1800 kg/ha to 400-600 kg/ha through the use of cut seed.

Can cut seed produce good crops in the tropics

A recent trial in Vietnam using cut seed originating from Western Australia produced a crop of 30 t/ha. Given that the average yield in Vietnam is 12 t/ha, this is a substantial gain in productivity, demonstrating that cut seed can succeed.

The success of the Thai farmers in using cut seed and reducing their seed costs is attributed not only to the skills they have developed, but also to their crop rotations and the fact they only use cut seed which has been imported. Their rotation includes at least one rice crop and it is thought that the flooding of the fields eliminates bacterial wilt, the major factor influencing the poor quality of locally produced seed. For a similar reason, the regular use of imported seed also helps prevent the perpetuation of the disease.

It seems that there is a window of opportunity for Australian seed growers to tap into those markets where seed cutting is already practised, or where the rotations support the use of high quality seed.

The current situation in South East Asia

The major constraint to the expansion of the potato industry in South East Asia is the inadequate supply of reasonably priced, good quality seed potatoes of the desired varieties.

Seed is the most expensive input required to produce potatoes, comprising between 34-50% of production costs. This is because the seed used is several generations old and of poor quality which substantially reduces the productivity per hectare.

Despite the financial benefits which may be achieved from the use of high quality seed, good quality seed is not only very difficult to obtain, but very few farmers have sufficient financial resources to be able to purchase it.

Why good quality seed is scarce

The lack of a successful certified seed production system in South East Asia makes it very difficult for a farmer who wants to buy good quality seed. Since the majority of seed crops are harvested from ware crops, the risk of infection is high unless farmers have taken the time to select those plants that are true-to-type, vigorous and healthy, or to remove those plants which show symptoms of disease.

There is also a very high natural occurrence of bacterial wilt in the majority of the soils used to cultivate potatoes in the tropics and, particularly in the highlands, crop rotations are inappropriate to control the disease. This means the potential for infection is particularly high. The situation is further aggravated by limited seed storage facilities.

Small whole seed preferred

Because of the high risk of infection, the majority of farmers in South East Asia prefer to use small round seed, despite the cost savings achieved by using cut seed.

Whole seed generally produces a heavier crop, the percentage emergence is greater and there is less likelihood of spreading disease and further contaminating the crop from which seed is usually harvested to produce subsequent ware crops.

The size of the seed used will have a major influence on the quantity of seed required per hectare and the cost per hectare. If large seed is used, a greater weight of seed will be required to achieve the same plant density and the costs of establishment per hectare will be considerably greater. Given the farmers financial constraints, the ideal seed rate is 1.6-1.8 tonnes per hectare; hence the ideal seed size is 40-45 grams.

Impact on Australian seed growers and exporters

The South East Asian farmer's preference for the use of small round seed is believed to provide the largest single constraint to the immediate expansion of Australian seed potato exports.

Numerous visits to Indonesia, Thailand, the Philippines and Vietnam have indicated repeatedly that seed supplied from Australia is considered too large for the market. URC, the largest manufacturer of potato crisps in the Philippines, have indicated that they will not accept seed larger than 50 g (20 tubers per kg).

Given that the majority of the potato crops grown in Australia are planted using cut seed and that it costs substantially more per tonne to produce small round seed under the current methods of production, there is very little incentive for seed potato producers to maximise the production of small round seed.

Whilst in the longer term every possibility of increasing the harvest of small round seed must be examined, it seems there may be opportunities for Australian growers to export larger seed for cutting into areas such as Thailand and Vietnam.

Acknowledgements

The financial support of the AusAID AAECP Linkages Program is acknowledged in supporting this project. ■

Crop grown from cut seed in Asia

Potato market growth:

a strategy to realise the potential

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The Australian potato industry has opportunities for expansion through a combination of domestic and export market activity.

A key to domestic expansion is stimulation through product differentiation based around fitness for use and promotional activity.

However, there are substantial barriers to export growth and returns are generally modest relative to the domestic market. These relatively low returns on export raise the question of whether the capital, land and particularly scarce water resources are used to best advantage with potatoes or whether other more attractive cropping options should be considered.

The Potato Export Market Development project being conducted by a team led by Dr David McKinna has come up with a range of important findings so far.

The study has revealed the very close integration between the domestic fresh, processing and export markets within our major competitors such as the Netherlands, USA and Canada. This allows them to achieve economies of scale, critical mass and a degree of cross subsidisation.

It is now essential to grow for specific markets and to match growing areas and scheduling to meet market opportunities and to improve competitiveness.

Strategies to develop export markets

Industry clusters

These are based around growing areas linked to supply chain management and marketing programs and can help achieve critical mass and economies of scale in production, packaging, marketing and distribution for processing, fresh domestic and export.

Voluntary uniform product description and labelling systems/QA

It is desirable that there be a uniform product description, labelling and quality management system that would provide a trading language and product integrity mechanism covering all potato markets. The meat industry has discovered that this type of system can give the industry a huge competitive advantage in the export market. One of the key features would be labelling around variety, growing area, fitness for purpose/use with protocols to ensure reliability of product quality and performance.

This system would form the basis for a highly targeted promotion program built around trademarks and branded products.

Promotion

There is strong evidence that consumers would respond to promotion and marketing activities. The best results will be achieved through brand and product specific marketing where the value of the individual products can be promoted rather than a generic promotion like “eat more potatoes”.

The product description system outlined above would provide the vehicle on which to base a promotional program.

Export market development

The industry could become involved in market development activities including:

- identification of market opportunities
- participation in trade shows
- trial shipments
- market intelligence
- market access protocols
- freight regulation

Some of the larger exporters are involved in these activities to some degree at present and may not welcome the prospect of sharing the benefit with other participants and yet in some areas there are big gains to be made collectively.

Market intelligence

An essential element of any successful export operation is comprehensive, timely, accurate market intelligence. There are opportunities for the industry to establish a network, which provides the industry with weekly reports from all major markets.

Market access

There is a need for work to be done on establishing protocols to open up markets, which are not accessible because of pests or diseases, such as Japan and Taiwan. An industry co-ordinated approach (for example a potato markets access committee) would probably be more effective than individual effort.

Freight negotiations

There are some potential gains from a consolidated approach to freight negotiations and consolidation of container loads covering different vegetable and fruit products.

The next step is for detailed discussion with some of the key industry players in the lead up to a workshop with the aim of identifying areas for collaboration and co-operation to grow the domestic and export markets.

Acknowledgements

This project is funded through the HRDC levy system with support from the Department of Natural Resources and Environment, Victoria.

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Potatoes for export need a soft touch

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Potato production in Australia is big business. However, Australian export of potatoes is very low. A major reason is the high level of post harvest decay that can be experienced during non-refrigerated transport.

The biggest post harvest losses of potatoes in Australia are from infection by *Fusarium* dry rot and bacterial soft rot (*Erwinia*).

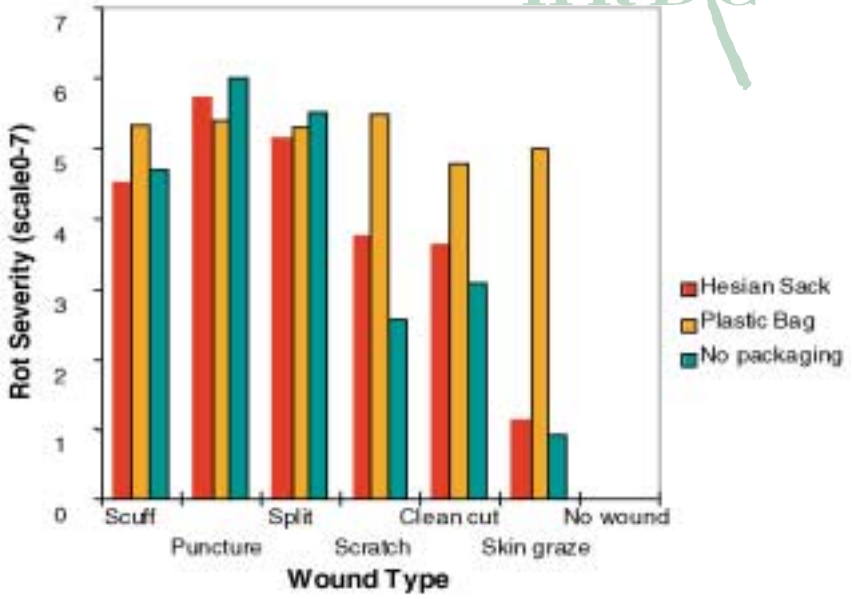
As part of a project looking at transport and disease control systems for exported potatoes, experiments using artificially wounded and infected potatoes of the variety *Red Pontiac* were carried out to establish how important environmental and physiological factors are on the post harvest infection process of potatoes.

The effects of wound healing, wound type, presence of surface condensation and packaging material were examined for both dry and soft rot. Experimental conditions were tailored to reflect the commercial situation in Australia.

The results clearly show that when potatoes are packaged in plastic, there is an extended period between harvest and sale or the tubers are not stored under refrigeration, then losses due to post harvest rots can be considerable. The type and extent of damage to the potatoes is critical to the losses sustained.

This means that for potatoes intended for export without refrigeration, careful harvesting, handling and grading to prevent wounding is absolutely critical.

Fig. 1 Effect Of Wound Type And Packaging On Fusarium Infection



Wound type

The type of wound suffered by a tuber had a big influence on the development of both *Fusarium* and *Erwinia* rot. Examination of several samples of potatoes obtained from the Sydney Flemington markets showed three common injury types:

scuffs - a rough break in the skin, containing crushed or bruised tissue

splits - ragged fissures penetrating tuber flesh

skin grazes - minor skin abrasions with no underlying tissue damage.

Fusarium was found to grow in each of these wound types. The severity of infection increased as tissue damage increased from minor to severe.

Clean, cut wound surfaces and minor tissue abrasions were highly resistant to infection by *Erwinia*, whereas injuries containing crushed or split tissue became severely infected within 48 hours. Importantly, uninjured potatoes did not become infected with either *Fusarium* or *Erwinia*.

Source of infection and surface moisture

The source of the infection and moisture on the tuber surface also seemed to have a big influence on the development of bacterial soft rot, particularly in injuries containing crushed or torn tissue.

Diluted, rotting potato tissue, applied to wound sites, produced dramatically more soft rot development than a pure bacterial culture. Presence of water (induced by removal from cool storage) on tuber surfaces caused a dramatic increase in development and severity of soft rot, particularly when rotten tissue was used as the source of infection.

In commercial practice potatoes are often packaged slightly damp, or removed from cool storage temperatures into a warm environment prior to transport which encourages condensation on tuber surfaces.

Benefits of curing and fungicide on postharvest decay

Natural wound repair

Curing is a process of natural wound repair. It is achieved by holding potatoes at a constant humidity and temperature with good air flow after harvest. Wounded potatoes cured for seven days, then inoculated with *Fusarium* and *Erwinia* and held under conditions of non-refrigerated transport were extremely resistant to disease development. Curing was as effective as the best post harvest fungicides at preventing rots.

Packaging material

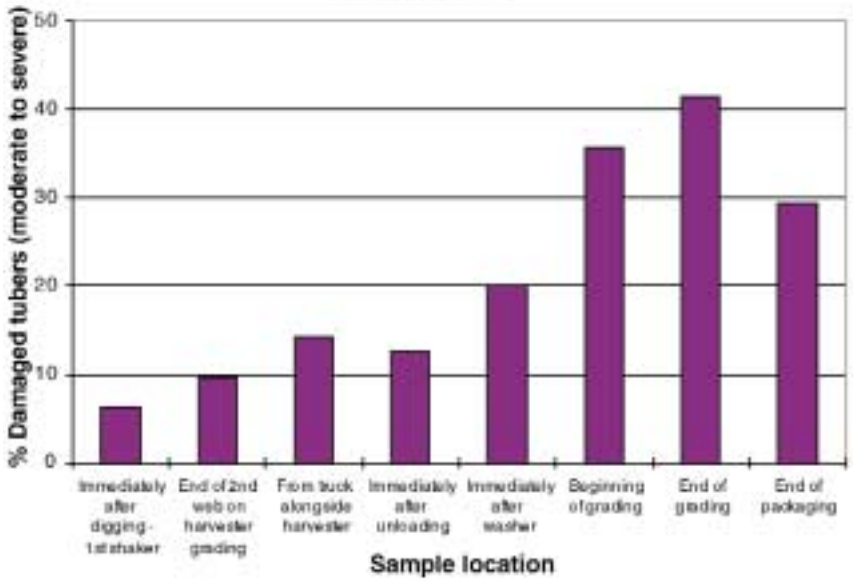
The type of packaging material alone had little effect on the development of *Fusarium*. Undamaged tubers packed in hessian bags did not develop any more rots than tubers left loose, whilst tubers packed in plastic only showed a small increase in the amount of rots.

However the interaction between packaging material and wound type had a relatively large effect on rot development.

Tubers with severe wounds containing crushed or torn tissue became highly infected no matter what the packaging material.

Wounds with minor tissue damage, such as grazes and scratches, showed a dramatic increase in the occurrence and severity of infection when potatoes were packaged in plastic. The increase was particularly obvious for minor skin grazes, which is one of the most common wound types found in Australian potatoes.

Figure 3. Dry rot in Australian potatoes after 4 weeks of storage at 20°C



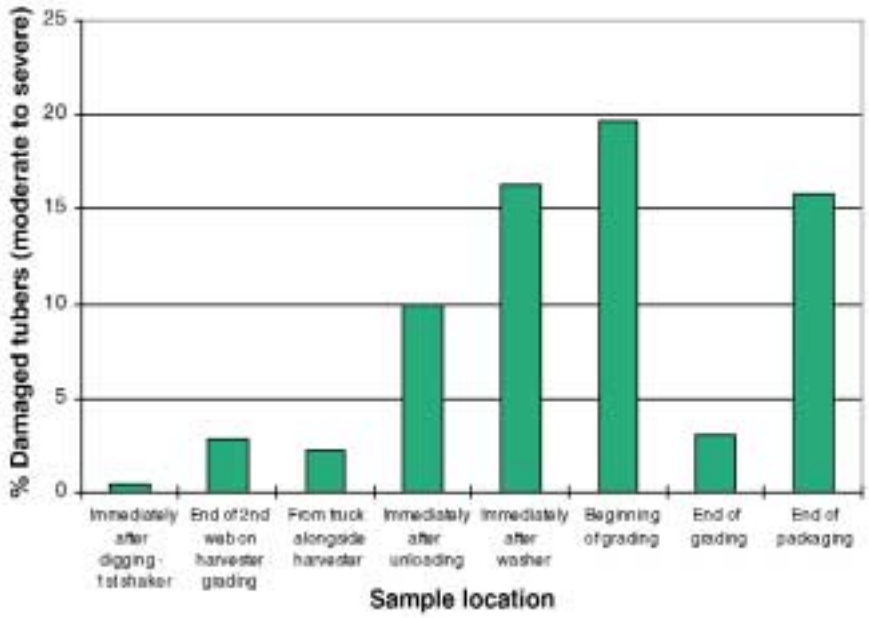
Avoiding post harvest rots

It appears that post harvest rot can be reduced by:

- Avoiding mechanical injuries of the type that contain crushed, bruised or torn tissue; these are highly susceptible to development of both *Fusarium* and *Erwinia* rots. The degraded tissue provides a nutrient source for establishment of the organisms and also keeps wounds moist, thus slowing wound healing.
- Use of wound healing. Curing of potatoes could be a practical means of reducing both bacterial and fungal infection in Australian potatoes.
- Avoiding the presence of free water on injured tuber surfaces. This makes them highly susceptible to *Erwinia* soft rot infection. The rotting tissue then provides a source of infection which may easily be spread to other potatoes.
- Avoiding plastic bags. These encourage *Fusarium* growth, particularly in minor injuries. The most likely reason is that air flow in other forms of packaging is higher, allowing shallow wounds to dry quickly, which makes it difficult for *Fusarium* to survive. Plastic packages retain humid conditions around the potatoes, an environment in which *Fusarium* can thrive.

Clearly injury is the common aggravating factor in the story of post harvest rot. Avoiding it is the best way to maintain potato quality, and the best way to do this is to understand where and when injury occurs.

Figure 2. Split type of injury in Australian Potatoes



Survey of types of damage in Australian potatoes

Since the type of damage has been shown to be critical to post harvest losses through decay, a survey was undertaken to get a better idea of the type and extent of injuries and decay found in a range of farms and districts in Australia.

Nine farms were included in the survey from three states; NSW (Robertson), Victoria (Ballarat) and South Australia (Mt Gambier, Pinaroo). Samples of potatoes were taken from each stage of harvesting and packaging. Half of each sample was examined immediately and the rest of the sample examined after being stored for four weeks under conditions similar to an export voyage to Asia.

The most common type of damage (moderate & severe only) was skin graze. This seems to increase going

up the harvester webs, but does not change much after that. The next most common type was splitting. This injury seems to be almost entirely caused in the packing shed, particularly from unloading and washing (see Fig 1). Other types of injuries (bruise, L puncture and scuff) were low in incidence, but generally tended to increase in severity through the harvesting and packaging operations.

Levels of dry *(Fusarium)* and soft rots *(Erwinia)* were low at harvest. After four weeks storage at 20°C, there was a very large increase in dry rot, but little change in soft rots. The dry rot problem seems to be considerably increased at the washing stage in the packing shed (see Fig 2).

District differences in damage and losses

NSW, Robertson: Overall levels of damage were very low, except for some skin grazing. Skin grazing levels were highest -17%, versus -10% SA and - 7% Ballarat. This problem was made worse by a very dry season and harvesting from dry sandy soils.

VIC, Ballarat: Levels of damage were low. The most common problem was skin grazing, but a small amount of splits and bruising and soft rots were also observed. The harvesting was done from very wet soils.

SA, *Mt Gambler & Pinnaroo:*
These districts had the highest overall levels of damage. Splits were the worst problem, with this largely occurring during packing. The next most common were skin grazing and bruising with damage levels increasing particularly through the packing shed. Dry rots after storage were a particular problem for this district.

Acknowledgements

We wish to thank the growers involved in the survey.The project is funded by the HRDC and the national potato levy. ■

Average levels of damages in Australian potatoes during harvesting, grading and packaging operations.

Type of Injury	% Damage	Severity Limit
Skin graze	11.2	>2% surface area
Split	8.8	>10 mm long & 3 mm deep
Bruise	5.8	>50 mm^2 & 3 mm deep
L puncture	3.1	>10 mm long & 3 mm deep
Scuff	2.8	>50 mm^2 & 3 mm deep
Embedded stone puncture	0.5	>2 mm deep
Soft rot (freshly harvested)	0.8	>50 mm^2 & 3 mm deep
Soft rot (after 4 weeks storage)	2.6	>50 mm^2 & 3 mm deep
Dry rot (freshly harvested)	2.4	>50 mm^2 & 3 mm deep
Dry rot (after 4 weeks storage)	21.2	

Effect of calcium nutrition on decay of summer sown seed-potatoes

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Soft-rot breakdown of seed tubers regularly causes economic loss to ware farmers in the irrigated sand-hill production areas of semi-arid southern Australia.

The problem is largely restricted to on-farm produced seed-tubers kept over from the summer (December/January) harvest and which are later planted during the following February. Certified seed-potatoes, produced in the cooler regions of Australia, seldom develop soft-rot but suitable certified seed is not always available nor is it perceived as economic - except in retrospect.

Severe outbreaks of seed-piece decay were evident throughout the region following the February planting season. As shown in the photo cultivar choice made a big difference to soft-rot susceptibility and it was evident that *Coliban* was the most severely affected of all varieties in the area. Seed breakdown was often observed in the bins prior to planting with some growers washing and grading seed prior to planting in an effort to eliminate infected stock. Others believe these operations only serve to spread infection.

What do we know about soft rot

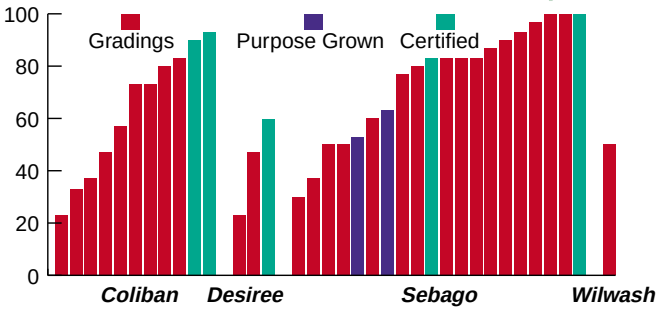
Soft rot is caused by the bacterium *Erwinia carotivora* which produces an enzyme that breaks down the "cement" holding the tuber's cells together.

The conditions which are likely to promote soft rot development are wounding, high temperatures, water logging and soils with low amounts of clay such as sandy loams with poor ability to hold nutrients.

Previous laboratory studies have shown that tubers with high calcium levels are more resistant to *Erwinia* soft rot. However supplying extra calcium in the fertiliser at planting has given variable results.

It seems that potato plants send calcium to the leaves in preference to the tubers so that the amount of calcium received by the tubers can be quite variable.

Varieties can make a difference to the level of seed piece breakdown. In this MIA sandhill crop established in late March 1999, Desiree was planted on the left and Coliban on the right. (NB the area to right of the pivot was over-sown twice.)



Percentage establishment rates at 10 weeks of growers sourced seed potatoes planted at the Yanco Agricultural Institute on 5/3/99

Can foliar sprays of calcium help

A project being undertaken in the Riverina/MIA is looking to see whether calcium applied as a foliar spray can satisfy the plants need to have calcium in the leaves so that the calcium taken up by the roots can go to the tubers, making them less susceptible to soft rot. A field trial is beginning in September 1999 to examine this.

In the meantime, samples of seed have been collected from potato growers in the district for three studies:

1. field establishment trial
2. resistance to *Erwinia* inoculation
3. calcium content analysis

Field establishment trial

As shown in the graph, certified seed nearly always out performed the seed graded from a previous crop. There was an enormous range in how well the seed established, depending on where it was sourced from.

Half of the *Coliban* samples planted had an establishment of less than 60%. In comparison only 26% of the *Sebago* seed lines had an establishment of less than 60% If there was a replacement cultivar for *Coliban* the incidence of seed piece breakdown in the Riverina/MIA would be significantly reduced.

Resistance to *Erwinia* inoculation

Sub-samples of the seed used in the establishment trial were deliberately infected with soft rot while others were merely wounded and still others were left intact as a control. After 21 days at 28ºC incubation, breakdown was evident in many of the control tubers, suggesting that infected seed makes losses almost inevitable during periods of elevated temperature during storage or after sowing.

There were major differences in soft-rot development between seed samples but these have not yet been analysed in relation to either establishment or calcium levels.

Calcium content analysis

Determination of tuber calcium levels in the cell sap and walls is currently under-way at the Waite Institute in Adelaide.

Acknowledegments

This project is made possible with the assistance and cooperation of Riverina and MIA potato farmers and the HRDC.

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Pink rot control

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Chemical control of pink rot has been evaluated in several field trials over the last four years and the most effective treatment currently available is Ridomil®, which can be applied to soil as granules or as a foliar spray.

Results have shown that, although both forms are effective against pink rot, the granular application results in higher yields.

No direct comparison of the spray application of Ridomil Gold MZ with the granular rate has been made. However it has been suggested that two foliar sprays (each at a rate of 1.25 kg/ha) applied at tuber initiation and 14 days later could be just as effective as a granular application of 20 kg/ha at planting.

The granular application should be watered in with the normal irrigation practices. The foliar spray should be irrigated by an overhead sprinkler every 2-6 days to enhance the leaching of the fungicide from the foliage on to the soil.

At the present costing of around $34.60/kg for Ridomil Gold MZ and $16.50/kg for the granules, two sprays each at 1.25 kg/ha costs around $86/ha compared to $330/ha for the granule treatment.

Granular application at planting may be the most appropriate in areas where high levels of pink rot have been detected while foliar sprays may be the best option in other pink rot affected areas.

Unfortunately recent work in North America has shown that some strains of the pink rot fungus are not controlled by Ridomil in many potato growing areas. So far tests show the fungus is still controlled by Ridomil in Australia, however it is important that we continue monitoring the situation especially if such formulations are to be used more widely to control pink rot.

Phosphoric acid has been evaluated in both field and glasshouse experiments at different rates and timings. However it has proved to be unreliable and as a result cannot be recommended for pink rot control. Alternative chemicals, as well as biological agents, are being evaluated which hopefully will provide a similar level of control thereby reducing our reliance on one fungicide.

Further investigations will include an evaluation of in-furrow sprays of Ridomil at planting, at rates equivalent to the granular applications. Tuber seed treatments, such as washing and fungicide treatments to control tuber infestations will also be evaluated. Other studies will include disease spread in storage, the use of potential biocontrol agents and alternative management such as the use of bio-fumigation and cover crops. ■

Pink rot - the disease

Tuber infection can be detected initially by cutting the tuber and checking for pink coloration, infection can then be confirmed by laboratory tests.

Symptoms

Infected **plants** wilt and collapse due to rotting of the crown area of the stem.

Infected **tubers** are initially spongy and rubbery and then breakdown due to the development of secondary soft rot bacteria.

Infection

Can occur both in the field and in store. Pink rot can be introduced into new areas on seed tubers carrying symptomless infection or in infected soil adhering to the surface of the tuber. Tubers carrying infection through storage can also produce infected plants.

Susceptible cultivars

Kennebec, Desiree, Russet Burbank, Coliban, Sebago, Pontiac, Atlantic, Shepody, Ruby Lou, Shine, Crispa, Nadine, Bison

Cause

The fungus *Phytophthora erythroseptica*

Pink rot control recommendations

High disease incidence

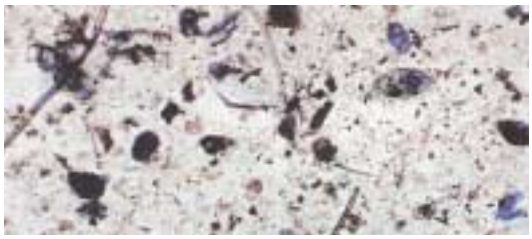
Apply Ridomil granules at planting at 20 kg/ha.

Low disease incidence

Apply Ridomil Gold MZ as a foliar spray at tuber initiation and 14 days later.

Irrigate after each application to leach Ridomil into the root zone.

Hygiene in the potato shed - a role for disinfectants?



This is an air sample taken from a potato shed and viewed under a microscope (x 400 magnification). Among the dust particles are powdery scab sporeballs (stained blue) and pieces of rhizoctonia (blue and brown threads).

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Hygiene in the potato shed? Why bother cleaning a potato shed when potatoes are covered with dirt anyway!

Well, the potato shed has been identified as a source of disease, especially of seed potatoes (see *Potato Australia Vol. 9*). The spores of many potato pathogens (disease-causing organisms) have been found in dust and air samples collected from potato sheds (Table 1).

This means that valuable seed stocks are at risk of contamination with disease as dust and spores are blown about in the sheds. It is very important, therefore, that the sheds are kept clean.

Table 1:
Potato pathogens detected in dust from potato sheds

Potato disease	Organism
Black dot	*Colletotrichum coccodes*
Black scurf	*Rhizoctonia solani*
Fusarium dry rot	*Fusarium* spp.
Gangrene	*Phoma exigua*
Powdery scab	*Spongospora subterranea*
Silver scurf	*Helminthosporium solani*

So how do you clean a potato shed

Research in the United States and Scotland has been looking at effective ways to clean potato sheds. Keeping dirt and fine dust to a minimum is a vital first step in the process. Smooth concrete flooring is essential, and removal of the dust is most important.

Seed growers would be well advised to regularly vacuum the traffic areas within the shed, as is recommended practice for Scottish seed producers. Walls, boxes and grading lines should be washed between seasons.

Should we be using a disinfectant

Potato pathogens are tiny microscopic organisms which could be lurking protected in crevices and cracks. Hospitals and dairies finish off their cleaning routines with a disinfectant to kill any remaining pathogens. Can disinfectants be effective against potato pathogens in the shed?

Studies in the UK found that mechanical cleaning alone removed 60 - 90% of contaminants such as silver scurf, dry rot and gangrene spores. Disinfection further reduced the levels in most cases.

It must be stressed, however, that disinfectants are not a 'quick fix'. They will not work unless mechanical cleaning has first removed the dirt and dust.

So which disinfectant should we use

In order to answer this question, we need to consider the range of disinfectants that are available. Just as 'oils ain't oils', unfortunately disinfectants ain't disinfectants either!

Several different groups of chemicals are used as disinfectants, each with their own set of pros and cons (Table 2). Many lose their effectiveness in the presence of organic matter and soil. Some are toxic or hazardous to use, while others are environmentally unfriendly and difficult to dispose of. Several are corrosive and will shorten the life of expensive equipment.

Recent studies in Scotland have also shown that the recommended dilution on a label may be effective against, say, bacteria but not against fungi, or may disinfect wood but not concrete. So the story is by no means simple.

Research project

Most disinfectant products have a general label and do not make specific claims about their effectiveness against specific pathogens.

Research is currently underway at Agriculture Victoria's Institute of Horticultural Development in Knoxfield to evaluate the effectiveness of some commercially available disinfectants against common potato pathogens. Our aim is to provide specific recommendations for the potato industry, drawing on information gathered from a variety of sources and supported by our own studies.

Several disinfection treatments are being tested under laboratory conditions at this stage, and it is expected that a short list of promising products will soon be selected for further testing under commercial conditions.

It must be remembered that disinfectants are only part of the answer.

This research is part of an HRDC-funded project investigating cleaning and disinfestation practices for potato farms. The project aims to provide growers with practical disinfection practices, as part of farm hygiene, to help improve potato quality and minimise the risk of the inadvertent spread of the major seed and soil-borne potato pathogens.

The outcome will be to develop cleaning and disinfection practices specifically for use by potato growers.

Acknowledgements

This work is funded by HRDC and the Victorian Department of Natural Resources and Environment.

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Table 2: Disinfectant groups: their pros and cons

Disinfectant group	*Inactivated by organic matter*	*Corrosive to metal*	*Activity dependent on pH*	*Safety*	*Comments*
Alcohols e.g methylated spirits	No	No	No	Relatively safe (see comments)	Flammable; can irritate skin; cracks rubber and plastics.
Aldehydes e.g. formalin	No	No	No	Poisonous	No longer recommended; toxic and carcinogenic, causing rashes, nausea and asthma attacks.
Chlorine dioxide	No	No	No	Irritant vapour	Comes as two components (base and activator) which are mixed together when required for use.
Hypochlorites e.g. bleach	Yes	Yes	Yes	Irritant vapour	Quick-acting and inexpensive, but activity is lost rapidly.
Iodine compounds	Some	Yes	Yes		Similar properties to hypochlorites, but more stable.
Peroxygens e.g hydrogen peroxide, peracetic acid	No	Some	Some	Varies	This group varies in toxicity and corrosiveness, so generalisations cannot be made.
Phenolic compounds	No	No	No	Poisonous	Suspected carcinogen. Activity lost rapidly if diluted below recommended concentration.
Quaternary ammonium compounds	Yes	Slight	Yes	Use caution (see comments)	Many different types of QACs, often formulated as mixtures. Diluted disinfectant relatively safe, concentrated form poisonous.

Understanding *Rhizoctonia*

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Damage caused by the fungus *Rhizoctonia solani* is common in potato crops world wide resulting in reduced yields and poor quality tubers. The black scurf symptom (reddish-black crusty structures on the skin that cannot be washed off) has become a major problem for the washed, fresh market and seed potatoes growers alike.

Research around the world on rhizoctonia canker and black scurf spans several decades but there is still much to be learnt about this mysterious fungus.

What sort of damage can *Rhizoctonia* do

Rhizoctonia affects the underground parts of potato plants. Damage to sprouts, stems and stolons appear as reddish brown to grey depressed lesions or cankers and sprouts, stems and stolons may be pruned. This process can be repeated several times on sprouts with successive re-sprouting below the damaged area.

Above ground symptoms include slow or patchy emergence, reduced stem numbers and stunting of individual plants several weeks after emergence. In mature plants, symptoms include yellowing or reddening of foliage and cupping of the leaves (rosette symptom). Plants may wilt and die. In extreme cases, particularly after hot dry weather, several plants in an area can wilt and die leaving bare patches in the crop.

Plants with stem damage remain green long after the rest of the crop has dried off. They typically have short, thickened stems with small green-reddish aerial tubers in the leaf axils. Severely affected plants can produce large numbers of very small tubers or one or two very large tubers.

If tubers are infected at initiation, the resulting potatoes can have patches of russetting on the skin, cracking, deep russetted pits, dimple ends or blind eyes. The black scurf symptom develops on mature tubers. As a potato crop dies off and tubers mature, chemicals produced by the tuber stimulate the fungus to form survival red, black crusty structures called sclerotia.

Where does the disease come from

Rhizoctonia can be both seed borne and soil borne. The fungus survives on decaying organic debris in soil and on the roots and stems of volunteer potatoes. Sclerotia and fungal threads on the skin of seed potatoes are also a source of disease in new crops. The relationship between the amount of sclerotia and fungal threads on seed and the severity of damage in the crop is not known. More research is needed to determine the black scurf threshold for seed-borne infection.

What about other hosts? The fungus can colonise the underground parts of many different plant species without causing damage. The question is whether these hosts can maintain populations of the fungus without potatoes being present? We have some more work to do to determine if our rotation systems, particularly pastures, reduce or support populations of *Rhizoctonia*.

Rhizoctonia is a complex organism with a number of different strains. Three strains known to infect potatoes around the world also occur in traditional potato cropping areas in Australia. However, it seems that some native strains may be infecting potatoes in new areas never previously cropped to potatoes. Until we know which strains occur in our cropping systems and their respective impact on potato production, we will not be able to accurately predict disease risk in the different cropping areas.

Conditions that favour the disease

Infection of sprouts and stems is most likely under low temperatures and humid soil conditions. For much of its time *Rhizoctonia* colonises the underground parts of the potato plants without causing symptoms. However, when plant growth is slow, due to cold or other stress factors, the fungus is able to infect and cause cankers. Sclerotia (black scurf) on the tuber skin develop under cool, humid conditions. The development of black scurf is slower after mechanical vine kill than after chemical vine kill.

Stem canker and black scurf appear to be particularly severe in nutrient poor, sandy soils. This is perhaps because *Rhizoctonia* has less competition from other soil microbes under these conditions and because damaged plants are less able to cope with stress in these environments.

Can *Rhizoctonia* be controlled with chemicals

Registered chemical treatments (applied to seed tubers just before or at planting) of seed with black scurf can give good control of early sprout damage and black scurf on the daughter plants and tubers. This shows that seed borne *Rhizoctonia* is an important source of infection in the crop. However, these treatments will be no more effective than planting disease free seed. Research shows that some of the disease that develops on plants and tubers is also due to the *Rhizoctonia* that inhabits the soil.

Soil fumigation with chemicals such as Metham can reduce the severity of stem canker and black scurf but is only of benefit if disease free seed or chemically treated seed is planted in the treated soil.

Prevention and management of *Rhizoctonia* canker and black scurf

Although there is still a lot to learn about this disease, there are a number of steps that can be taken to minimise the risk.

- Avoid growing potatoes in short rotations (i.e. less than one crop in every three years).
- Plant only clean seed.
- If there is a risk that seed carries even low levels of black scurf, apply a registered *Rhizoctonia* seed treatment.
- Ensure that sprouts emerge quickly after planting to minimise the risk of damage.
  - warming seed before planting (above 15ºC)
  - ensuring that seed is sprouted (do not plant dormant seed)
  - planting no more than 5 cm deep
  - don't plant in cold, wet soils
  - harvest tubers as soon as possible after vine death to reduce the risk of severe black scurf
  - try to avoid stress in crops by ensuring, adequate nutrition and adequate and even irrigation of the crop.

What do we still need to learn about this disease

There is much to learn about *Rhizoctonia* in the unique environment and cropping systems in which potatoes are grown in Australia. A better understanding of the different strains of *Rhizoctonia* in new and traditional cropping systems and the role of the different rotation crops play in the survival of the fungus will help towards predicting disease outbreaks and developing more effective management strategies.

Acknowledgements

Stem canker and black scurf caused by *Rhizoctonia solani* is a major focus of a research project on the effects of rotation and biofumigation on soil-borne diseases of potatoes supported by APIC and HRDC, the Victorian Department of Natural Resources and Environment and the South Australia Research and Development Institute.

Fresh potatoes from Elders

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Elders, known for its involvement in the animal industries (wool, stock selling), has moved into horticulture with a significant involvement in potatoes. Elders has become the head licensee for several potato cultivars from the UK based Caithness Potato Breeders Ltd. (CPB) group.

Elders formally signed an agreement with CPB in December last year allowing it the full marketing rights for CPB bred potatoes in Australia. This arrangement means that Elders will be testing and multiplying several potato cultivars over the next three years when there will be enough seed for commercial planting.

CPB potatoes generally have low to medium dry matter, set a high number of tubers for high yield potential and size evenness, and have been tested in UK markets which are similar to Australia. The most well known potato from the CPB program is *Nadine* which is doing well in Western Australia and increasing in popularity as a premium washed potato from South Australia. *Nadine* is being trialed in several areas along the east coast of Australia to see if this cultivar will be a washed or brushed potato for local fresh markets.

Plant Breeders Rights (PBR) protects licensees such as Elders who develop and manage supply of potatoes by creating a legal way of controlling who can get PBR protected potatoes and to collect licensing fees. Licensing fees are used to cover the costs of developing and managing the supply of new potato cultivars and reinvest in future potato cultivars.

Of course, the potato would need to have some special features to make it attractive for the market chain in the first place. This naturally means that there will be aggressive searching and testing of new potatoes for the Australian fresh potato industry so the industry will look quite different in 5-8 years time. ■

New variety for Queensland

For many years, *Sebago* has been the traditional potato variety for Queensland. This potato has been surpassed by other varieties in areas of yield and shelf life.

Primac-Elders has just made available to growers small amounts of the Caithness potato *Nadine* which has proved successful in southern areas of Australia. The seed supplied will be used for a trial crop to judge possible future growing and marketing of this fresh market variety in Queensland.

Queensland areas that will be trialing *Nadine* will include the Lockyer Valley, Cleveland, Bundaberg, Darling Downs and the Atherton Tablelands.

Primac-Elders will be monitoring the progress of these potatoes throughout the life of the crop and will be reporting the results in each area after the crops have been grown.

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Improving our ability to diagnose disease

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Disease diagnosis is an increasingly important component in today's high value horticultural crop production.

Without accurate and rapid identification of disease causing organisms, the correct disease management cannot be implemented.

To accurately diagnose diseases, both training and experience are required. Experience is mostly obtained "on the job," but training requires specialist input. To this end, I attended a six week "International course on the Identification of Fungi of Agricultural Significance", at CABI Bioscience in the UK in August/September 1998.

CABI Bioscience is part of a large multidisciplinary organisation for scientific research and training, with a focus on assisting underdeveloped countries manage their agricultural problems. This course is run annually by CABI Bioscience, and introduces participants to the main groups of fungi and their identification.

Benefits in attending the course

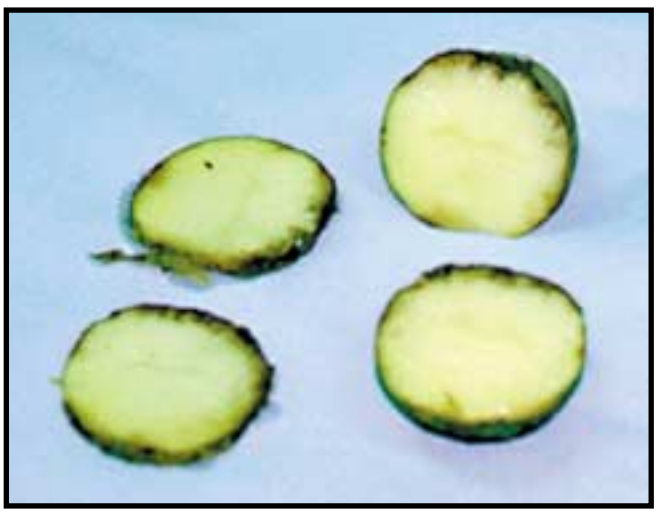
In addition to updating my skills in fungal identification, and ensuring that the latest diagnostic techniques are employed in Australia, another result of the course and subsequent visits to diagnostic laboratories, was the development of overseas contacts. This network exchanges information on new and better techniques for identification as well as new diseases that have been discovered.

Laboratory at CABI Bioscience with some course participants

Some overseas developments in potato diseases

As in the USA and Australia, Verticillium is becoming an increasing problem in seed tubers in the UK, and one laboratory is starting a program to investigate how many of the seed tubers are internally infected. An Elisa test is being developed to undertake this, testing a new commercially available antisera. We are keeping in touch with the developments in this, with a possibility of importing the new technology once successfully adapted.

Some potato diseases occurring in the UK are not in Australia, and a combination of importing only tissue culture plants rather than whole tubers, an ability to recognise these diseases and good quarantine practices should keep it this way. One such disease which is becoming more of a problem in the UK is Potato Tuber Necrotic Ring disease. Caused by a new strain of potato virus Y, it causes deep rings in the tuber surface, and *Nadine* and *Desiree* are two varieties grown in Australia that are susceptible.



Late blight symptoms on potato tubers

The metalaxyl (Ridomil) resistant strain of late blight common in the USA now appears to be in the UK. It is more virulent and devastating than the sensitive strain, and caused much damage during their wet summer. The disease can be spread large distances by infected seed. Tuber symptoms include lesions on the surface which are "foxy red" when the skin is scraped off, and have finger-like projections into the tuber when cut.

I encourage all pathologists, experienced or "up and coming", to undertake regular training to keep their skills and knowledge up to date.

Acknowledgements

I wish to thank HRDC and the nursery, potato and vegetable industries for supporting this training course and the laboratory visits. Both were of great value to me.

■

Developing a product description language

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The concept of a pictorial language to describe the quality attributes of horticultural products is not new, but has mostly been applied to fruit crops.

Potatoes, being a high volume vegetable crop with significant variation in product quality and a strategy to increase export volumes and values, is another likely candidate for this approach.

Responsibility for potato quality rests entirely with suppliers and their customers, not an outside inspection agency. It is up to suppliers and customers to negotiate quality on a day by day, week by week, month by month, season by season or permanent basis. This is a cornerstone of quality management.

The cost of disputes over quality can be substantial. Disputes usually arise due to ambiguous specifications which use terms such as 'reasonably good', 'practically free', 'not many', 'not much', 'few', 'usually' and 'almost'. The time spent repacking and the cost of rejects, returns and discounts must be and can be avoided.

The use of a Product Description Language to clearly describe a specification and to train staff shifts the focus from packing down to a price to focusing on quality and customer satisfaction.

What is a Product Description Language?

A Product Description Language (PDL) is simply text and photographs used to describe a product. It focuses on the key quality parameters and describes them in a way that is readily measured, preferably objectively.

The PDL can be used by all members of the production and supply chain (growers, packers, distributors, merchants, processors, retailers, exporters and food service) to identify which quality attributes are important to them. It also provides the opportunity to specify what style of each attribute is either available to supply or acceptable to purchase. It does not specify product standards, but allows suppliers and customers to 'see what they mean' when negotiating their own specifications or discussing out-turns.

The Potato PDL is not intended to replace any existing grades or standards, but is designed to enable existing standards (usually retail, processor or seed) to be put into a language which can be adopted across the potato industry. This will assist each supplier in the chain to clearly understand what their customers want, which is a basic requirement of the quality systems now being implemented in the industry.

How to use the Potato Product Description Language

The Potato PDL comprises 64 loose leaf pages of photos each with just enough text to describe each quality parameter. There are three sections as follows.

Section 1 - Variety reference specimens

Some quality parameters relate to the shape, skin colour and flesh colour of the potato tuber. Because the many potato varieties available differ in these characteristics, photographs of 'typical' examples of a number of varieties are presented as a reference for traders.

Section 2- Quality parameters

This section presents a series of quality parameters related to potatoes. A brief description of each parameter is given, and three styles are presented where appropriate. Where possible, an objective measurement of each style is given (ie size of blemish).

For some quality parameters, presenting options at three levels is not appropriate because any level of the parameter will be unacceptable. This is particularly applicable to internal disorders of potatoes.

Within Section 2, quality parameters have been grouped as:

Section 2.1 Defects occurring during the growth of the crop;

Section 2.2 Damage caused by pests and diseases (at all production stages); and

Section 2.3 Defects occurring during handling and storage.

Section 3 - Aids to assessing quality parameters

This section provides known measurements of length, area and percent coverage of tuber surface, to assist in objective assessments of quality parameters. In addition, methods of measuring specific gravity and sugar content are described.

Industry Consultation

An essential element in the development of a market-based document like a Product Description Language is consultation, throughout development, with representatives of industry suppliers and customers (the seed industry, growers, packers, distributors, retailers, processors and exporters). The degree of co-operation experienced with this project has been exemplary. The following should be noted for their positive and useful contribution:

Eric Coleman, Gatton, and growers in the QA and Marketing project, Victorian Certified Seed Potato Authority, Neil Perry, (Potato Growers of South Australia), Red Gem Growers and Packers Pty Ltd, Costa's Pty Ltd, Franklins Ltd, Safeway, Coles Supermarkets, McCain Foods (Aust.) Pty Ltd, The Smith's Snackfood Company, Vlad Basa and Tony Kellock.

Acknowledgements

This work was supported by funding from Agriculture Victoria's ExpHORT 2000 Initiative (CQ-Potato project) and from HRDC. ■

The Product Description Language - Potatoes is available from Agriculture Victoria and the Australian Horticultural Corporation

Capitalising on electronic information technologies

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Other teams members include Leigh Walters (National Technology Transfer Project) and Barry Philp (Primary Industry & Resources South Australia)

New electronic technologies are changing the way Australians do business, offering new, more efficient services and savings in time and costs. This project has looked at how the potato industry can capitalise on these innovations.

Throughout this project we have aimed to do three things:

- increase awareness of electronic information products and services and what they have to offer
- collect information on what electronic information services would be useful to the potato industry and how they might be delivered
- develop a strategy for how the potato industry might begin to take advantage of the new technologiesThe information collected was presented back to the industry at a national workshop which was attended by people representing most parts of the potato supply chain.

These people were asked for their input into developing the strategy so that the way forward could encompass the views and needs of everyone in the industry.

One of the syndicate groups at the workshop

The workshop overwhelmingly supported the development of a national potato industry internet site. The participants told us that this should provide access to potato information and also to a comprehensive range of services across the supply chain. They said that the internet site should start off small but be developed to deliver the full range of services over time. They saw the following benefits in establishing a national potato internet site:

- provision of focused information on potatoes that is up to date and can be accessed 24 hours a day
- improved access to market and production information which may help reduce fluctuations in the supply chain
- provision of up to date news and short cuts to information services
- easier access to people and information, and in particular, expert information useful to the industry

The project team are now working on a proposal to bring this to fruition.

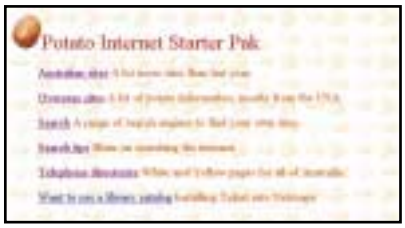
Some of the other outcomes from the project.

1. Increase awareness of electronic products and services and what they have to offer

Since *Eyes on Potatoes* is distributed to all participants of the potato industry, we have included a number of internet related topics over recent issues including

- article on how grower John Doyle uses the internet
- article on what's happening in the US potato industry with electronic technologies
- pull out brochure on electronic information services
- provision of internet addresses of various potato related sites

Leigh Walters has also produced a second edition of the Potato Internet Starter Pak, which provides links to over 400 potato internet sites around the world.



If you want a copy of the new version please send an email to Leigh Walters (lwalters@saff.com.au) and include in the subject box - Request for Starter Pak. In the area where you usually write your message type - Request.

Leigh has also been conducting workshops with growers throughout Australia demonstrating the use of various electronic technologies.

2. Collect information on what electronic information services would be useful to the potato industry and how they might be delivered

a) Identifying industry attitudes to electronic information products and services

This was achieved by conducting a series of focus groups with potato growers in Virginia (SA), Warragul (Vic), Berrigan (NSW), Crookwell (NSW) and Devonport (Tas). At the focus groups, three electronic technologies (e-mail, internet and CDROMS) were demonstrated. Comments were sought from participants both on the technologies and the services they could potentially provide. Discussions were also held with processors and service providers.

Chris Price, David Carter, Narelle Scott and Albert Kadwell at the Crookwell focus group

The views expressed by growers towards the technologies ranged from "yet another thing imposed on farmers" to "...going to be fantastic, especially in the future."

Those who had had the most exposure to the technologies were, in general, the most supportive of them and the most able to see how information services could be usefully delivered by such technologies.

Furthermore, those who had integrated the technologies into their farm or agribusiness appeared to be receiving the most benefit from them. This would support the theory that as electronic information services become available which provide industry members with real solutions to their information needs, they will begin to use them.

Growers indicated their main information needs related to crop management topics, in particular disease, pest and weed control, nutrition and irrigation. The other main need was for accurate and meaningful information on market prices. Growers strongly indicated that, regardless of delivery mechanism, they want information that is gutsy and to the point, simple to understand, practical and easy to access.

Agribusiness personnel generally had greater exposure to electronic technologies. They tended to utilise these technologies quite highly within their own organisation but not routinely to communicate with their potato grower clients.

Participants expressed a lot of interest in email, particularly in the transmission of photos from place to place. This technology was seen as having great potential in problem solving where all parties could see the same material.

There was general support for an industry specific internet site that provided a first port of call with links to all potato information, national and international. This has the advantage that all industry members would know where to go to obtain information related to potatoes.

CDROM technology was seen as a useful means of delivering information of a very narrow focused nature, such as nutrition and disease information and which is not prone to rapid change. These were considered to be of particular value if they were interactive allowing the user to input their own information to achieve custom delivered "advice".

b) Investigating overseas electronic information products and services

In 1998 Barry Philp undertook a study of electronic information services being provided to the United States' potato and horticultural industries. This study was undertaken as a separate HRDC project but the information gathered has been included into this project.

Services currently delivered to the US potato industry are:

- publications and printed information
- accessing services and personnel
- weather based crop management information
- questions and answers, getting advice
- crop expert systems
- weather and market information via data transfer network
- merchandising for farm needs
- video conferencing

With the emergence in the United States of a combination of pay television, web and telephone services, it is expected that further use of electronic information services in the potato industry will occur over the next few years. It is not only the information provision service, but adding value to that information and interpreting the information accurately for use by growers and others that sets the growth scene for the use of electronic information services.

As a result of the study, Barry has made the following key observations on issues that will have a significant impact on the success of electronic information services in Australia.

- The vision for the service must not simply be an information library, but rather a pro active service reaching out to growers, service providers and other users.
- Provide a human touch to the service to enable users to make contact with people and develop a network to harness the expertise and knowledge of researchers and others in the industry.
- Continually conduct market research on the customers and suppliers using the electronic information service to promote continuous improvement.
- It must be easy to use.
- Ensure that links between web sites and other information providers add value rather than simply shuffling the user from one screen to another.

c) Investigating electronic information products and services in Australia

This involved looking at case studies of existing electronic information services and products in use in rural and other industries in Australia that may have potential in the potato industries.

Case studies were developed to highlight major business services and information provision that can be delivered by electronic technologies. They include:

• Supply chain quality management

Services include automated product ordering and purchasing, ability to directly link buyers and suppliers.

• Industry specific on-line information

Services include access to industry specific market information such as imports, exports, trends, economic outlook, production volumes, networking events and potential business opportunities.

• Industry specific trading networks

Services include automated systems for pricing and product updates, commission calculations, billing and electronic funds transfer.

• Crop management, expert systems, weather

Services include expert advice and assistance for pest and disease management, weather forecasting and regional weather pattern information.

• Retailing of products and services

Services include ordering and receipt of goods from home.

• Video conferencing

Services include meetings via video saving travel time, access to specialists and provision of training.

d) Options for commercialising electronic information products and services

A number of possibilities for funding an electronic information system for the potato industry were considered.

The model suggested was to use seed money from the potato levy plus a grant from other electronic technology funding sources to get an initial internet site established. At that stage it was proposed to move towards a self funding operation possibly through franchising or contracting out certain services to suppliers wishing to provide those services.

Another option is for the potato industry to link with the Fresh Chain network being established to service horticultural industries nationally. Opportunity exists for the potato industry to use this platform to deliver a range of information and services electronically without having to develop its own business or delivery mechanisms.

Acknowledgements

The project team would like to acknowledge the assistance of the consultants, Systems Intellect and Ag*knowledge* and all those who attended and helped organise the focus group sessions, industry discussions and the workshop. ■

Evaluation of potato publications

To determine how well the national potato publications *Potato Australia* and *Eyes on Potatoes* are meeting industry needs, market research was carried out by McGregor Marketing. The first stage of the research consisted of two mini-group discussions and five in-depth interviews with readers, contributors and advertisers/advertising agencies. The information gathered was used to help develop a questionnaire. The second stage of the research consisted of telephone interviews with growers, people working in the service industry and advertisers throughout Australia.

The following is an extract from the full report which will soon be available from the Horticultural Research and Development Corporation.

The Australian Potato Industry Council publishes *Potato Australia* and *Eyes on Potatoes* which together provide a quarterly communication forum for the national potato industry.

The publications are the main vehicles for disseminating information on research outcomes within the industry but are also, and increasingly, covering a wide range of industry issues. They are distributed nationally free of charge to all Australian potato industry participants (growers, merchants, agribusiness, government and processors) with assistance from the HRDC and the Potato Levy.

The magazines have a distribution of about 3000 with around 600-700 in Tasmania and Victoria, 300-400 in each of Queensland, Western Australia, New South Wales and South Australia.

Since these publications are financed by the potato industry in conjunction with associated advertising, it was essential to determine to what extent the magazines meet the needs of the industry and whether changes are required. Information on how best to attract advertising was also sought.

McGregor Marketing was commissioned to undertake research on these issues.

How it was done

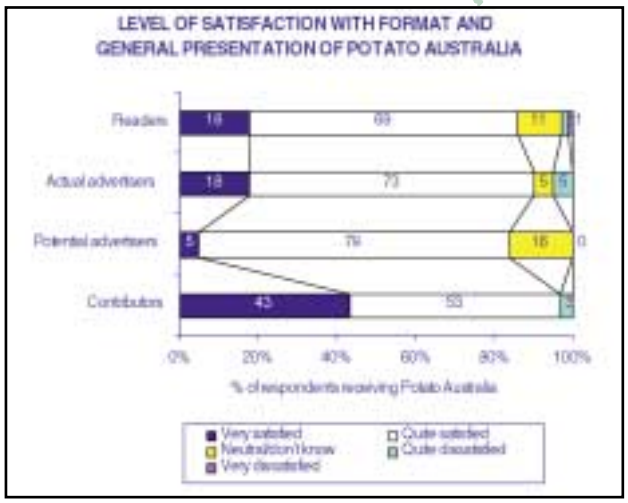
The first stage mini groups and in depth interviews were conducted in December 1998 and January 1999. The second stage survey was conducted from 4-8 March 1999 and included 337 telephone interviews with growers/service providers from distribution lists, 30 contributors, 22 actual advertisers and 20 potential advertisers.

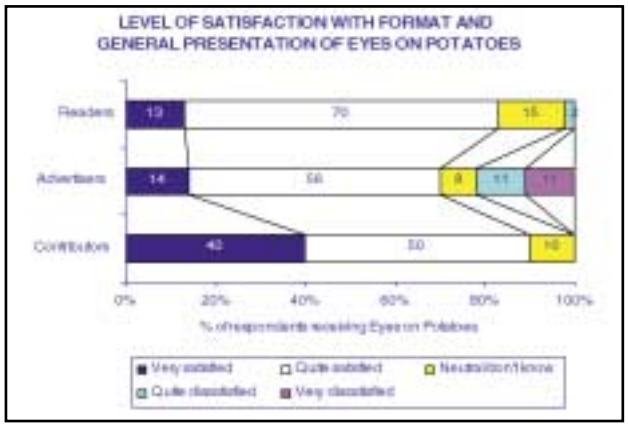
General findings

The research indicated that there is a high level of satisfaction with both *Potato Australia* and *Eyes on Potatoes* and that the industry supports the use of levy funds to assist in the production of these publications.

Format and general presentation

Contributors cited the greatest level of satisfaction with the format and general presentation of both *Potato Australia* and *Eyes on Potatoes*, although the overall level of satisfaction was very high in all segments.

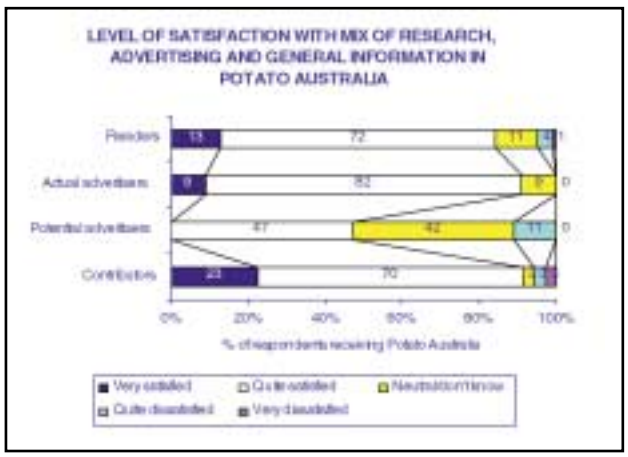


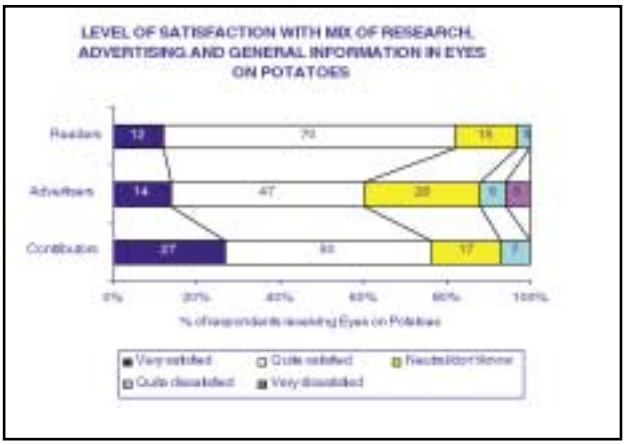


A similar pattern also followed for *Eyes on Potatoes*, with four in ten contributors very satisfied with the format and general presentation, compared with less than 15% of readers and advertisers. Advertisers were the only group to record any extreme dissatisfaction, although the overall satisfaction level remained very positive.

Content

Contributors cited the highest levels of satisfaction with the mix of research, advertising and general information in *Potato Australia*, while potential advertisers showed the lowest level.

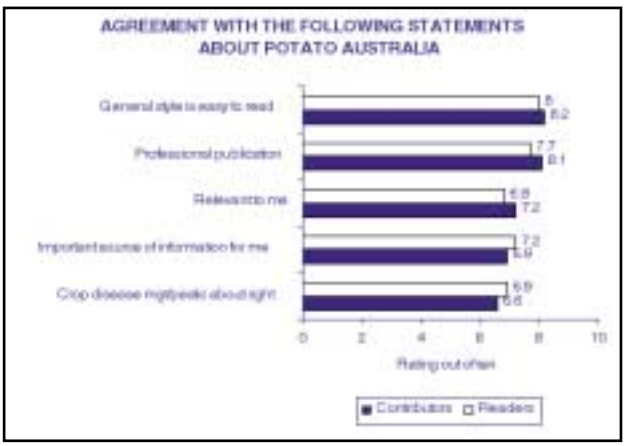




For *Eyes on Potatoes*, readers recorded the highest level of overall satisfaction with the mix of research, advertising and information although contributors had a higher incidence of being very satisfied.

Readers and contributors were asked to rate a number of statements about the two publications.

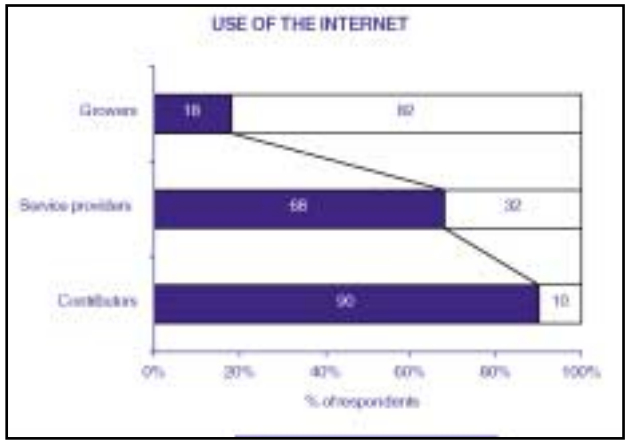
General style is easy to read topped the list among both groups. *An important source of information for me and the space allowed for crop disease management and pesticide issues is about right* were rated slightly higher by readers.



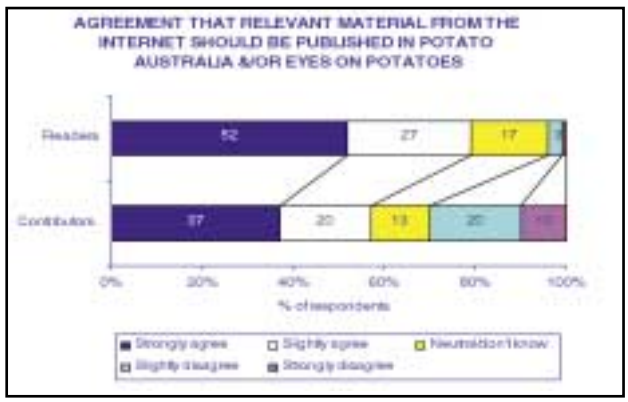
All statements about *Eyes on Potatoes* were rated fractionally higher by readers, with general style easy to read again emerging as the most favourable perception.

Use of the internet

Internet use was far more predominant among contributors than readers. Service providers showed a significantly higher proportion using the internet (68%) than growers (18%).

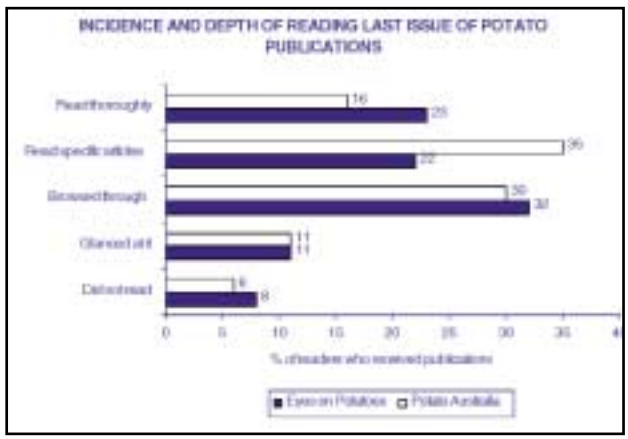


Perhaps due to the lack of access to the internet, readers showed a higher level of agreement that relevant material from the internet should be published in *Potato Australia* and/or *Eyes on Potatoes*.

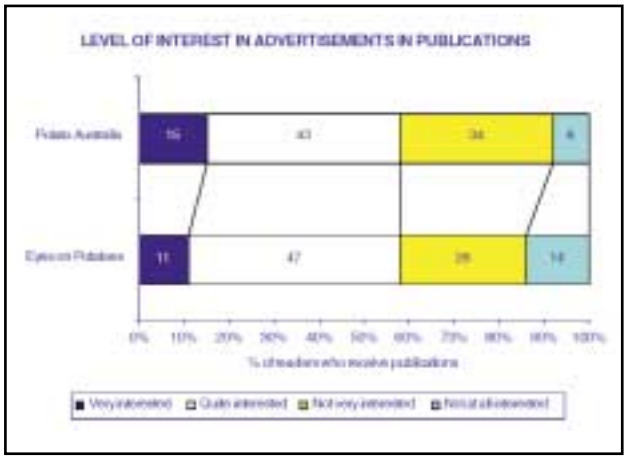


Reader-specific findings

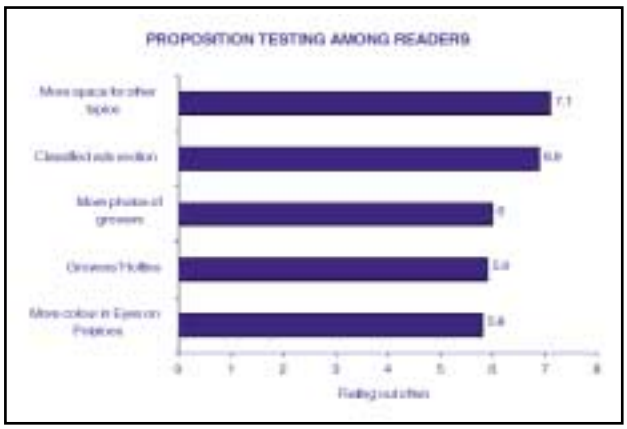
- The majority of those who recalled receiving the publications had read the last issue they received (92% *Potato Australia*, 88% *Eyes on Potatoes*).



- Overall 62% of readers keep both publications, 16% keep only *Potato Australia* and 4% keep *Eyes on Potatoes* only. 18% do not keep either.
- Contact with other farmers/farm groups/cooperatives and with the Department of Agriculture/Primary Industries were the two main sources which readers use to obtain information (34% and 32% respectively).
- Almost half of the readers surveyed thought the balance of articles about growers and other topics should remain the same (47%). 32% favoured more articles about growers and 22% more articles about other things.
- Six in ten readers who received either the magazine and/or the newsletter were interested in the advertisements.



- The majority of readers considered no aspects of the publications needed improvement (57% *Potato Australia*, 72% *Eyes on Potatoes*). In fact, no specific improvement could be named by more than 7% for the magazine and 2% for the newsletter.
- Two thirds of readers were aware that their potato levy funds are used to subsidise *Potato Australia* and *Eyes on Potatoes*. Overall 86% considered the levy was put to good use.
- As stated previously, three in ten readers surveyed use the internet, of these 95% agreed that relevant Web-site addresses should be published in the magazine and/or newsletter. Eight in ten readers agreed that relevant material which is available on the internet should be printed in the publications.
- Of five propositions for the publications rated for their interest to readers, more space for other topics achieved the highest interest level at 7.1 out of 10.



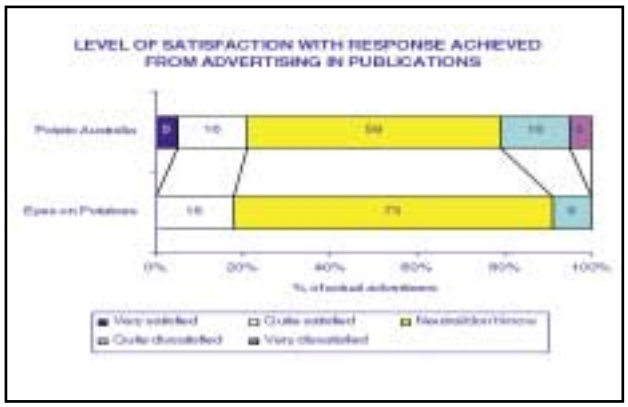
Advertiser specific findings

The majority of advertisers were aware of both publications (98% *Potato Australia*, 86% *Eyes on Potatoes*).

Three in five actual advertisers in *Potato Australia* placed advertisements in every magazine edition, while just 16% had done so in the newsletter.

Seven in ten had placed advertising in publications other than *Potato Australia* or *Eyes on Potatoes* relevant to the potato industry. Good Fruit and Vegetables was the predominant publication named (66%).

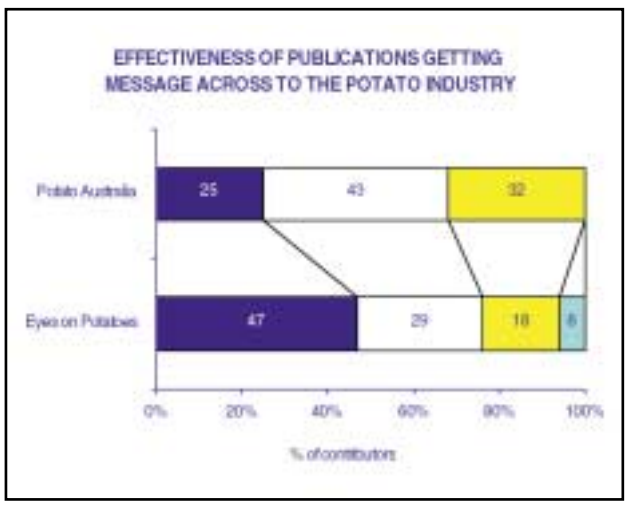
Satisfaction with the response from advertising was similar among those who placed advertisements in *Potato Australia*, (21%) and/or *Eyes on Potatoes* (18%). But, in both cases, a high proportion of respondents were neutral or didn't know (58% *Potato Australia*, 73% *Eyes on Potatoes*).



Contributor specific findings

The majority of contributors had published in *Potato Australia* (93%) and some 57% of contributors had published in *Eyes on Potatoes*. The predominant reason for contributing was the distribution profile of the publications (61% *Potato Australia*, 82% *Eyes on Potatoes*).

The majority of respondents considered the two publications effective in getting their message across to the potato industry (68% *Potato Australia*, 76% *Eyes on Potatoes*).



Half of *Potato Australia* contributors and two thirds of *Eyes on Potatoes* contributors could not name an aspect upon which the publications could improve.

Acknowledegements

The editors would like to acknowledge the support of NSW Agriculture, Queensland Fruit and Vegetable Growers, South Australian Farmers Federation, McCain Foods, Simplot Australia, Harvest Moon, Rolf Vos Purity, Max McKenna, Ag-Challenge and Potato Growers Association of WA for their assistance.

We would also like to thank all those who so willingly participated in the survey.

The project was commissioned with funds from HRDC. ■

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