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Horticultural Research Study Tour of USA and Europe for Australian Potato, Carrot and Onion Producers

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Wesfarmers Landmark

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Horticulture Australia

OVERSEAS TRAVEL REPORT

Horticulture Australia Limited
Project No. VX00032

Horticultural Research Study Tour of USA and Europe for Australian - Potato, Carrot and Onion Producers

USA, Holland and Scotland

July/August 2001

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1. SUMMARY

A study tour of potato, carrot and onion producing areas in Idaho, Washington State and Oregon as well as potato production areas in Holland and Scotland was undertaken by a Australian group consisting of growers, chemical distributors and researchers in July-August 2001.

The group inspected numerous farms, processing plants, chemical distributors, machinery manufacturers and research farms.

Some of the main points of interest were :-

1. The large scale production of potatoes and the equipment used to facilitate planting and harvesting operations that need to be done in limited time.

2. Most of the USA potato industry based on Russett Burbank.

3. Differences in standards demanded for fresh washed potatoes between Australian and American consumers.

4. The USA potato industry based on stored potatoes.

5. Widespread use of fertigation and chemigation.

6. Increased use of remote control of irrigation systems.

7. The widespread use of large machines to apply fertilisers with air booms and variable rate applications according to soil analysis.

8. Use of regular infra red aerial photographs as an aid to monitoring crop health.

9. High standards of seed health maintained by regular inspection and testing of seed potato crops in USA and Europe.

2. INTRODUCTION

The study tour was been designed to take into consideration the key production objectives of Australian horticultural producers.

The focus of the study tour was aligned with horticultural row cropping namely potatoes, carrots and onions. Areas for study during the tour were many and varied. However key study issues revolved around: remote sensing and irrigation practices, precision agriculture, produce storage and packaging, transportation, production techniques, produce processing, new varieties, harvesting techniques and agronomic extension. Inevitability other crops and study opportunities come to light during the course of the tour, which enhanced the overall learning experience.

3. USA

3.1 Simplot Technical Section

Simplot is a diverse US based Agribusiness involved in the production, processing and marketing of fertiliser, vegetable, dairy and meat products

Laboratories and other research and development facilities at the Simplot enterprise at Caldwell were inspected. At the technical section, analytical services undertake studies on pesticides residues, hazard analysis, waste water analysis, contaminants, foreign matter and heavy metal contamination. Studies were also undertaken on fat and oil analysis and the development of speciality blends of oils used in processing.

The product development section was also inspected and examples of new lines of potato and salad blends, incorporating seasoning as well as products with fast preparation time were sampled.

This section also conducts extensive taste testing of various lines and have a specialised team of tasters who have been screened and calibrated.

Pilot plants to evaluate various processing techniques had been installed and tested in this facility. This has resulted in numerous patents being awarded to Simplot for equipment and techniques used in the vegetable processing industry. Because of this, photographs within this facility and others operated by Simplot were prohibited. Also it was pointed out that laboratory notebooks and other documentation for the laboratories was stored in a locked safe after hours.

3.2 Gross Farms

Potato production on a farm near Caldwell was inspected where Norkoda, Ranger Russet, Shepody and Miltito Russet were grown. Seed obtained from North Dakota and Idaho was

cut by the grower just before planting. A four year rotation was used on the growers own land and a five to seven year rotation on rented land. Crops used in rotation were corn, alfalfa and cereals.

Average production was 20 tonnes/acre. Telone is regularly applied for nematode control whereas Metham is applied for Verticillium wilt. Telone is injected 16 to 18 inches deep and Metham shanked at 4, 8 and 12 inches in rows 10 to 12 inches apart.

A 2.25 ounce size seed is preferred with the upper size of 3.5 ounces. Seed is cut at the rate of 30 tons/hour. Cut seed is treated with a formulation of Macozeb (6%) or Maxim mixed with pulverised Alder bark. Cut seed is stored in trucks for at least 1.5 days before planting.

Either Maxim or Quadris is applied in furrow at planting to control Rhizoctonia.

A new product oxygrow (gamma, amino buteric acid) applied at tuber indication and 21 to 28 days later has produced increased yields. This product stimulates stress in plants but its effect relies on critical spray timing and the correct rate. The product has also produced significant yield increases in onions.

3.3 Potato Handling Equipment

Several manufacturers of potato handling equipment, particularly harvesters, windrowers and seed cutting machinery were inspected.

The first of these was Spudnik Equipment Co., a major manufacturer of potato harvesters situated in Blackfoot, Idaho. Brochures on some of the windrowers and harvesters manufactured by this company are shown in the appendix. Other equipment produced by Spudnik included planters, conveyors, dirt eliminators, picking tables, bulk beds and semitrailers and conveyors.

A number of second hand harvesting units were also inspected and depending on freight costs, these may have been economic to ship to Australia.

Other manufacturers were Milestone, also situated in Blackfoot, Idaho. This company specialises in potato seed cutting machines as well as dirt/store eliminators, even flow bins, and potato seed dusting equipment. Although this was a family run business they appeared innovative and willing to incorporate growers suggestions onto any line, thus making specialised machines. The cutting machines were very impressive and incorporated a patented star sizing roller that increased the accuracy and consistency of cut seed size. These manufacturers have an email address and website which is shown in the appendix of this report.

Six and eight row planters manufactured by Harriston Industries, Minto, North Dakota were also inspected on several commercial properties. These planters were based on electrically controlled hydraulic motors that metered seed into the planting shoot.

Harvesters, windrowers and other machinery produced by the "Double L" company at America Falls, Idaho were also inspected. This company also has all equipment listed on their web site at www.doubleliin.com.

Another major display of potato handling equipment is organised by the British Potato Council which was held at the Newark Showground – in the UK during 4th to 5th September 2001.

3.4 Onion Production – Idaho, Oregon

Onion plantings grown with dripper irrigation were inspected in Idaho. In this planting the "T" tape irrigation was installed before planting to a depth of 4 inches with 12 inches spacing between the holes in the tape. Onions were irrigated in 12 hour sets using 4/10 inch or 1/3 inch of water per day. In this area the soil borne fungus causing white rot had not been found although the area had been fumigated with a mixture of Telone chloropicrin. White rot had previously been found in onions in the area but the planting had been quarantined and the soil treated.

Other crop problems were thrip, although Malathion, Lannate, Vydate and Parathion had been used for the problem. Diseases encountered were downy mildew —controlled with Mancozeb and bacterial problems controlled with Kocide and damping off controlled with

Ridomil seed coatings. Fusarium basal rot was a problem if bulbs split due to over watering. Sprays were usually applied at night to protect bees used to pollinate alfalfa crops that grow adjacent to the onions.

Inspecting onions grown with dripper irrigation - Oregon

3.5 Onion Harvesting Machinery

Onion harvesting machinery manufactured by TopAir machinery Idaho were inspected. This company started in 1993 appeared to be innovative and receptive and continually adopting to new ideas and concepts into the machinery. They manufacture 30-50 machines per year - costing around US$ 70,000 to $75,000 each. The machines are centred on a 60 m.p.h. blast of air that forces leaves upwards allowing them to be removed with a cutter bar. Leaves and trash are removed by the air blast. A prototype machine to harvest green leafed plants is being developed.

3.6 Onion Packing Facilities

Several onion packing facilities were inspect in Idaho and Oregon. The largest was the Murakam Produce Company in Ontario Oregon – about 100 km west of Boise, Idaho. At this site storage and packing facilities were situated on 30 acres with storage in 13 buildings. Onions were stored in wooden bins and over 55,000 bins were utilised. This company was the largest company in Western USA and shipped out over 100 trucks of onions per week.

New packing lines were being installed to pack 50 kg bags at over 2,000 bags per hour. This line was built with an infrared camera to sense for internal sprouting and skin blemishes.

Onions were stored at 75 to 80% relative humidity (RH) between September to May and during this time they shrink about 6 to 8% due to moisture loss.

One of the more interesting lines was the 12 cm diameter "Awsom blossom" onion, a large onion sold exclusively to certain restaurants where it is sliced deep fried and served as an appetiser. These large onions sell at US$10 per 22kg bag.

3.7 Tape Irrigation of Onions

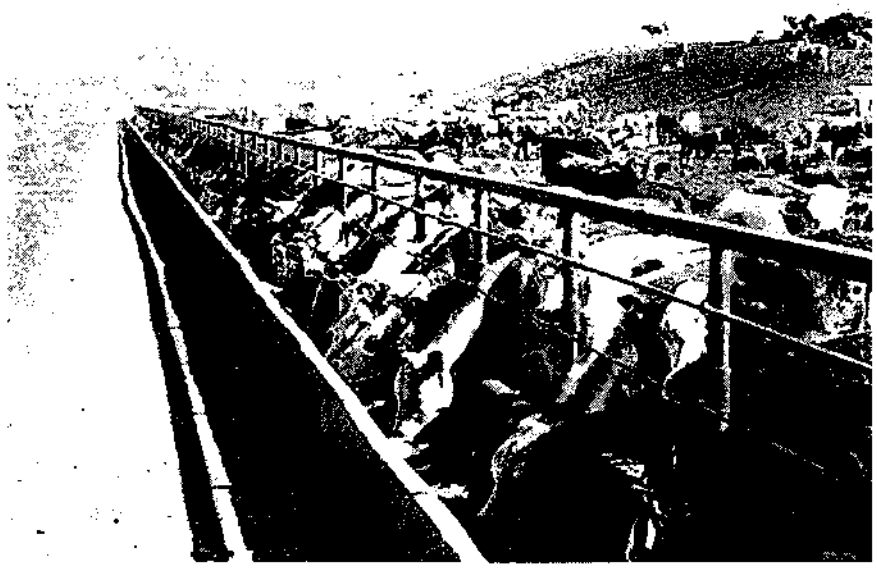
A further large onion planting irrigated by underground drip was inspected in Oregon on Skyline Farms. In this farm, irrigation by centre pivot had unsuccessful due to uneven soil infiltration rates. Drip irrigation using 4, 6 and 8 ml tape had been tested and 6 ml "T" tape installed as this created sufficient turbulence in the line to prevent blockage. The tape is installed to depths of 3 to 4 inches before seeding. Tape costs around US$130-140 per acre with a total of around US$800 per acre set up. Irrigation is applied in 8 hours shifts using 0.16 gallons per hour per 100 feet of tape. The tape is replaced every year although similar tape is reused in California. The tape needed continual inspection to check for leaks, many of which were caused by deer and antelope nibbling the ends of the tape where salt accumulated. The water was applied in pulses to achieve good lateral movement in the soil and to ensure that the profile was never saturated. On this property over 40 acres were irrigated by drip with the top run out in quarter mile long runs where the pressure was 8 to 10 psi. Old tape was pulled out and rolled up before harvest and stored in a land fill. Recycling of the tape is not done due to the accumulated salts in the tape.

3.8 Simplot Feed Lot

An extensive feed lot complex operated by Simplot in Idaho was inspected. This feed lot was set up in the 1950's to feed excess wastes from Simplot potato processing plants to cattle. Although this is still the case corn, silage and other vegetable matter is also used to feed the 130,000 cattle held in the area.

Cattle are fed three times per day and held in pens each containing 250 animals. The cattle are fed for around 160 days and shipped out at the rate of 2,000 animals per week.

Disease did not seem to be a problem although pneumonia was cited as the main cause of poor animal health.



Cattle feed lots – Oregon

3.9 Aberdeen Research Station – Idaho

The Aberdeen Research Station which services the Idaho potato and small grains industry in the areas of plant pathology, entomology, genetics and agronomy was visited and discussions held with various researchers. The station is situated on 480 acres with 420 acres irrigated and set up into 5 acre plots. Over 84 people are employed with 160 in the summer.

Areas of particular interest was the Precision Irrigation System. This system has banks of different nozzles on a centre pivot that are set up to respond with different outputs according to moisture levels in the soil. Complex electronic systems are needed to adjust to the variations of soil moisture so that it is maintained at optimum levels.

The system is very complex and sophisticated and has not been developed commercially. Other systems of using remote sensing to measure soil moisture levels are also being evaluated.

A large potato breeding program is centred in Aberdeen and is run by Dr. D. Corsini of the USDA and the University of Idaho. In this program over 2,000,000 potato plants are grown from seeds derived by crosses. Plants are grown in the glasshouse to produce mini tubers which are then planted out in the field. Plants are selected in the field for yield size distribution of tubers, disease susceptibility, appearance and other defects. Selected lines undergo further evaluation that includes storage quality and chipping and processing quality.

Selected lines from this breeding program and others in similar programs from Washington and Oregon are tested extensively in the three states and the results of these tests are included in the annual Tri State Potato Variety Trials Progress Reports. The results of these trials are published annually by the Idaho Agricultural Experimental Station. Details on some of the trials are shown in the appendix.

The role of Genetically Modified Organisms (GMO's) and potato breeding were briefly discussed and it seems that due to the high degree of sensitivity to this issue, commercial use of GMO potatoes with "foreign" genes is unlikely in the near future. However, research in this area is continuing as the technique has been successful in incorporating resistance to Colarado Beetle (New Leaf) as well as Leaf Roll virus (New Leaf Plus).

Potato variety evaluation – Idaho

3.10 Hutterite Farm – Washington

One of the most impressive farms visited was operated by the "Hutterites", a religious community consisting of 18 families that run a 20,000 acre enterprise growing 4,500 acres of potatoes.

The farm appeared almost self sufficient with workshops set up with the latest equipment for moulding, cutting, bending metal or crafting wood.

This farm had designed and built self propelled 5 row harvesters that were now manufactured commercially with each costing US$500,000. Five of these harvesters were sighted on the farm. These machines are operated by one person and can harvest 1,200 tonnes per day and load a semitrailer in ten minutes.

Also present in the almost immaculate and tidy sheds were 8 row potato planters, cutting machines and seed dusting machines as well as a 740 h.p. tractor (Big Bud). The large tractor was used to apply the soil fumigant metham at 50 gallons per acre in areas close to the population. In more remote areas metham was applied through the centre pivot sprinklers.

On this farm potato seed tubers are sourced from at least ten separate areas with each sample kept separate in case one is diseased. All seed was produced from cut tubers treated with the fungicide Maxim formulated in pulverised Alder bank. A vacuum filter was installed on the seed treatment machine to enable the Alder dust to be recycled. The 8 row planters were set up with computer monitors so planting distances could be easily adjusted.

Seed pieces around 2 ounces were planted at 11 inch in 34 inch wide rows.

This farm also ran 147 pivots that required 4 maintenance people. Up to 75 pivots were in operation at any one time and all could be operated remotely from the central office. Sweet corn, beans and cereals were irrigated with water that contained 25% of recycled water from a local McCains processing plant. Nutrients, particularly K and nitrates in this water were monitored continually and the Department of Ecology notified on a daily basis how much of this water was used for each pivot.

Fertilisers were also applied by Simplot Soil Builders using variable rate spreaders.

This farm also utilised infra red photographs of the fields that were taken every two weeks. These were useful in showing up uneven watering patterns as a result of blocked or malfunctioning sprinklers as well as diseased areas such as those caused by late blight.

As in most potato farms in the USA there is a limited time available for planting and harvesting. On this farm 160,000 tonnes of potatoes were harvested in a three week period.

Self propelled 5 row potato harvester – Washington

3.11 Simplot – Precision Agriculture (Soil Builders)

Precision agriculture is becoming more widely used and promoted in potato production in North West USA. This was evident when we inspected a division of the Simplot organisation known as Soil Builders which was set up for fertiliser application. In this system, soils are sampled on a grid basis at known GPS points and analysed for various macro and micro nutrients. The soil profile map is fed into a computer on specialised equipment used to spread fertiliser. The system costs US$31 to sample and US$6 to apply fertiliser. Up to six separate products can be applied with the system that uses conducted air to spread the fertiliser.

The system identifies areas of poor soils which are unlikely to respond to increased fertiliser application and other areas that will respond. The general consensus was that the system more than pays for itself with overall increased yields up to 15% in some cases but an even bigger benefit was more even maturing of the crop. The three wheeled machine used for this work is known as "Terra-Gator" and costs US$350,000.

Soil samples need to be retested particularly after other crops are used in rotation.

Another system mentioned was to use aerial photographs to separate plantings into different zones of similarity. Soil samples were taken from the different zones and analysed and fertilisers applied to appropriate zones. This system was cheaper than the GPS grid system and generally resulted in 8 to 10% increase in yields compared to conventional fertiliser application.

Yield is also monitored with sensors on harvesting equipment but this needs to be continually checked and calibrated due to the presence of stones, clods etc. that may confuse the readouts.

3.12 Mercer Farms – Washington

Mercer Farms was another large enterprise in Washington that produced a wide variety of vegetable crops and vine grapes using water from the nearby Columbia river. On this farm at least 76 "circles" (centre pivots) were operated from a central office using a telemetry system to monitor circles situated up to 40 miles away. Up to 17 circles were monitored per person for each crop. Although sophisticated systems were in place to operate the irrigation systems, soil moisture was checked by hand and shovel.

Ground rigs were the preferred method of applying fungicides and specialised machines with 120 feet booms were used with permanent ground tracks established in the circles. With this system materials could be applied with one days notice with one sprayer treating over 600 acres a day provided a supply mixer truck accompanied the sprayer. Ground rigs utilised air injected nozzles that reduced spray drift due to the more uniform sized droplets.

Occasionally fungicides such as PCNB (Blocker) and Rovral were applied through the irrigation system. This was done in 2/10 to ¼ inch of water.

Metham was also applied in the irrigation system usually in November and in one inch of water. Areas were usually pre-irrigated to ensure weeds and fungi had germinated and therefore were susceptible to the fumigant.

This farm also used aerial monitoring of crops which were photographed every two weeks at a cost of US$16 per photo. Accurate records were kept of all chemicals used on the farm as many processors require at least three years of records and conduct regular audits. Residue analysis of produce was also regularly conducted.

Organochlorine residues were sometimes found where root vegetables had been planted on old orchard sites. Carrots in particular tend to scavage and store pesticides in the roots and could be considered as a good "trap crop".

Carrot harvest – Washington

Carrots were a major crop on this farm with *Sclerotinia, Alternaria, Cercospora*; powdery mildew and *Phythium* being the main disease problems.

Ridomil EC was applied at planting to control *Pythium* and wettable sulphur for powdery mildew. *Sclerotinia* was a major problem if carrots were not trimmed 2-3 weeks before

harvesting. In this area two biotypes of *Sclerotinia* are present – one susceptible to Rovral, the other not. Sand blast was also a major problem in carrot seedlings which was controlled by using straw to cover the beds and then using a pitter (wedger) to cause the straw to stand up. This protects the seedlings by breaking up the wind eddies.

Alternaria, another problem on carrots was not controlled with Quadris (Amistar).

Garlic was also grown as a seed crop on this farm as the high altitude inhibited insect vectors of virus. Up to one ton of garlic cloves produced 10 tons of seed (cloves).

3.13 Seed Potato Certification – Idaho

Discussions were held with Dr. Jonathan Whitworth who manages the seed potato certification and associated laboratory at Idaho Falls – Idaho. Approximately 50% of the Idaho crop is used for processing with the seed crop grown in the high altitude low yielding areas. In the USA each potato growing area (State) has its own potato certification agency.

In Idaho the certification agency runs a laboratory and green house to test seed potato crops. In the Idaho scheme there is zero tolerance for bacterial ring rot (*Clavibacterium*), Root lesion nematode (*Meloidogyne chipwoodii*) and Corky Ring spot (Tobacco Rattle Virus).

With the certification, crops are sampled twice, and at least 200 plants sampled per acre. A 400 tuber sample is also tested for each seed lot in winter months. These tubers are grown out in the warmer California climate, whereas other certification schemes grow out samples in Hawaii or Florida.

Aphid trapping is carried out in all potato seed growing areas, with the traps checked twice a week. Anti freeze is added to the traps to reduce evaporation and around 15 to 20 traps are exposed per growing area. Insecticides such as Admire are applied in furrow at planting to control aphids for at least 60 days from planting.

Barrier crops of winter wheat or sorghum are also planted around seed crops to reduce invasion by aphids.

3.14 Crop Protection and Fertiliser Distribution

Discussions were held with Simplot Soilbuilders who also distribute chemicals and fertilisers to potato farmers in the Columbia Basin (Tri-City area).

Soil samples are taken before planting and tested for nematodes to decide the need for fumigation. If required metham sodium (Metham) is applied at 45 gallons per acre, 80% via the sprinkler system (Chemigation) or 20% injected or shanked. The fumigant needs to penetrate to 14 inches into the soil and requires one inch of oxygen to carry the product to this depth. An extra lap of irrigation may be required to seal in the fumigant in warm weather.

Other products such as Quadris are applied in furrow at 6 ounces per ha for the control of Rhizoctonia.

Fungicides such as Dithane and Bravo are also applied through this pivot in about 1/10 inch or ¼ inch of irrigation. Some wettable powder formulations froth excessively when applied in chemigation systems. In these systems the paddle agitation system is run backwards and defoaming agents added to reduce the problem.

Green Peach aphids were the main insect problem although Colorado beetle and mites occasionally cause problems. Temik and Gaucho were applied at planting but the use of Temik is restricted to potatoes that go into storage.

3.15 Access to Water

Several farms in Oregon and Idaho have benefited from the recent power shortage in California. As a result of this the Californian Power companies have paid growers US$350 per acre not to irrigate crops as the water was of more value in generating electricity.

On the other hand, the USA government shut water off from 1,500 farms in Oregon as a result of a two year drought that reduced reservoir levels. Farmers were prevented from irrigating so that the water levels could be maintained to protect endangered fish.

In another similar case in Idaho, the government overruled an application by environmentalists to prevent irrigation from the Snake river so that ducks resting in the lagoon along the river could be protected. Competition for water is becoming a major issue in many areas with involvement from the state and federal governments as well as farmers and environmental groups.

4. HOLLAND

4.1 Wageningen

Discussions were held with Dr. W. Flier of Plant Research International at the laboratories in Wageneigen. Dr. Flier coordinates a large EU funded project investigating various aspects on the biology and control of late blight (*Phytophthora infestans*). Late blight has become a significant problem in potatoes throughout Europe and the USA mainly as the result of new strains of the fungus that are more aggressive than the old strains and resistant to the chemical Ridomil. In Holland up to 14 to 15 fungicide applications are used to control the disease in some years. One of the most commonly used fungicides Bravo (Chlorothalonil) can no longer be used in Holland due to its persistence in the environment.

Brown rot is still a problem in Holland particularly where crops are irrigated from canals or dams and where the weed host Bittersweet is growing. Brown rot is not considered a problem if alternate hosts are eliminated. The bacteria survive on fine hair roots on host plants.

Organic production of food is being promoted in Holland with 10% of production aimed for in the next few years. In most years conventional farmers achieve 20 tons per ha compared to organic producers of 15 tons per ha. If late blight develops – production in organic farms will be further diminished as copper sprays are not permitted in Holland.

5. APPLIED RESEARCH FOR ANABLE FARMING AND FIELD PRODUCTION OF VEGETABLES (PAV) - LELYSTAD, THE NETHERLANDS

Discussions were held with researchers and facilities inspected at the PAV Centre, Lelystad. Dr. Huub Shepers who is responsible for PAV's research into late blight stated that nearly 80% of the research effort is devoted to late blight. Fungicide efficiency, spray application have been investigated at PAV, and specialised spray equipment to apply different treatments to research plots developed. This equipment has reduced the time needed to apply treatments (which is important in the Dutch climate) but costs are DFL 60,000. Dr. Shepers is also president of the European Network for Development of an Integrated Control Strategy for Potato Late Blight and has provided details of the deliberation of this body. Laboratory techniques for cultivating the late blight fungus on detached leaves were also demonstrated.

Research on powdery scab was also discussed by Dr. C. Bus of the PAV. Of particular interested was the poster showing the variation in symptoms developing as a result of powdery scab infection on tubers of different potato cultivars.

Powdery scab symptoms are not always obvious on tubers at harvest but can develop when storage temperatures increase during storage or transit. This may cause problems with certification. Some cultivars produce scabs on roots with no symptoms on tubers. Dr. Bus also provided a copy of the recent proceedings of the First Powdery Scab Workshop held in Aberdeen – 2000.

6. THE DUTCH POTATO SEED INDUSTRY

The Dutch potato seed industry produces over a million tonnes of seed potatoes or 40,000 Ha, and exports much of this to countries such as Cuba, Egypt and South East Asia. The Dutch have developed a large export market and are considered as a result of their good seed certification scheme, and after sales service to the industry. However, recent problems with brown rot have resulted in more competition from Scottish, French and Belgium potato seed industries.

Inspection of Dutch seed potatoes is carried out by NAK, an independent foundation run by a Board of breeders, growers and merchants. The rules governing inspections are developed by specialised advisory committees consisting of various sections of the industry. These committees provide advice on all aspects of seed production such as dates for haulm killing and specific cultivars for different regions, aphid thresholds, late blight control etc.

To run the inspection service, NAK operates a central laboratory service mainly for pathogen testing employing over 66 laboratory staff and 111 field inspectors. Additional 150 staff are employed in peak season. The annual budget for the service is DFL 22 million. Growers pay DFL 400/ha for this service which entitles 3 field inspections (two during the season and one before haulm killing), a post harvest inspection and a 25 kg lot inspection before shipment.

One of the most important aspects of the inspection service is timely haulm destruction. This is to destroy the foliage to prevent virus getting into the tubers late in the season. Laboratory tests are also carried out and over 5 million tubers are tested annually.

If growers do not destroy the haulm on time the crop may be rejected for certification.

Farmers receive mini tubers (cost 17 cents each) which are multiplied for four years to produce "superior" material. A closed system of production is used so that there is no exchange of material or equipment between farms to avoid contamination. This was triggered by the widespread occurrence of brown rot in the Dutch seed industry.

The Dutch consider that these standards are much higher than that required for the EU standards. Many Dutch farmers were reported to have moved to France and Poland to produce seed potatoes. NAR were recently involved in EU aide projects to develop inspection services in Bosnia and also Poland. Apart from certification and inspection, NAR services are also used for soil testing for Potato cyst nematodes and rootknot nematodes to enable growers to plant the most appropriate potato variety. NAK are also involved in certification and inspection of farms and documentation for the production of food for "Eco" labels and the "Safe Food Production" required by many supermarket chains in Europe.

7. SCOTLAND

A. FIELD DAY

Trials and demonstrations at the grower field day "Potato in Practice" were examined at Invergarrie, Dundee. This event, sponsored by the Scottish Crop Research Institute, Scottish Agricultural College and the British Potato Council, is the main Potato Technology Transfer event in Scotland.

The event was well attended by over 400 potato growers and associated industry personnel. It was evident that considerable effort has been put in preparing the demonstrations which included:-

7.1 Haulm destruction in a seed crop

At this site, Dr. Fraser Milne of the Scottish Agricultural College, compared different chemical methods of haulm destruction. In seed crops mechanical methods are not used due to the potential of damaging plants and spreading diseases. Treatment evaluated were sulphuric acid (77%) applied at 330 L/Ha, Reglone 1L/Ha followed by sulphuric acid (330 L/Ha), Reglone 4 L/Ha applied with Spraymax, Reglone 4 L/Ha and finally Reglone 1 L/Ha followed by Reglone at 3 L/Ha.

Treatments were applied to the cultivar Nicolar planted May 11 and fertilised with excessive nitrogen to provide lush vine growth. According to Milne, many Scottish growers consider sulphuric acid as the best method of haulm destruction. However, it is expensive, requiring specialised contract growers to apply the treatment. In this demonstration all treatments performed well, although the split application of Reglone appeared most effective.

Using the split application, the first spray of Reglone opens up the foliage to allow the second application to penetrate the crop. Using Spraymax spray system did not appear to improve the control with Reglone. Costs were £75 per ha for sulphuric acid and £30 per ha for Reglone.

Another interesting demonstration at this site was the use of the SMART test developed by Syngenta to assess the suitability of soil moisture conditions for use of Reglone. This simple test should be adopted by Australian growers to prevent similar internal damage caused by applying Reglone when soil conditions are too dry.

Potato haulm destruction with sulphuric acid - Scotland

7.2 Black leg contamination of seed crops

Contamination of seed tubers with *Erwinia* soft rot bacteria is a major problem in seed production in the United Kingdom. New PCR based techniques for testing commercial stocks are being evaluated by Dr. I. Toth of the Scottish Crop Research Institute (SCRI), Dundee. Other aspects of this work are to determine if high levels of *Erwinia* contamination in mother tubers results in high levels in progeny tubers and what affect irrigation has on this transfer. Another part of this project described by Dr. S. Wale of the Scottish Agricultural College (SAC), Aberdeen was to determine the value of rouging out blackleg infected plants from seed crops. Results suggest that rouging may be of little value although others questioned this conclusion.

7.3 Seed Satisfaction Survey

Mr. Alasdair MacLennan, Head of Seed and Export for the British Potato Council presented some results of the 2001 seed customer satisfaction survey. Over 381 growers were surveyed with a 15% response. Thirty five thousand ton of seed is imported into the UK from the continent. The main concerns were availability of tuber counts in the seed lots and accurate sizing and grading. Disease of concern were viruses, brown rot, ring rot, silver scurf and black leg.

Most growers were willing to pay a premium price for quality seed. The British Potato Council is producing a seed buyers guide.

7.4 Response to Phosphate

Trials involving response to applications of phosphate were described by Barry Mitchell of the SAC. In the UK large applications of phosphate have traditionally been applied to potato crops, but the yield response is small unless soil P levels are low before application.

In the present trial three rates of phosphate (P_2O_5), 0, 75 and 150 Kg/Ha were applied to cultivars Estima and Maris Piper, but no marked increase in yield was obtained with either cultivar. Supplementary phosphate also had no significant effect on tuber numbers. Although further trials need to be conducted, these results suggest that current recommended rates for phosphate for potato crops in the UK need to be revised.

Present recommendations are for 50 Kg/Ha to be applied as maintenance treatment.

7.5 Cultivars for Different Uses

New cultivars developed from breeding programs conducted at the SCRI were demonstrated by Dr. G. Mackay. Cultivars targeted for the organic grower (e.g. Lady Balfour) as well as novelty and salad potatoes were presented. Many of the new cultivars have a broader range and higher level of resistance to various pests and diseases. According to Marshal, updates of

these new cultivars will enable the UK grower to maintain productivity at lower cost in a more sustainable manner and open up more export potential for the seed sector.

Descriptions of some of these new cultivars are found in the appendix of this report.

7.6 Effect of Physiological Age of Seed Tubers

A trial on physiological age of seed tubers was described by D. MacKerran of the SCRI. In this trial tubers of either Premiere (an early cultivar), Maris Piper (the main crop) or Cara (a late cultivar) were planted following treatments of unsprouted (held at 4°C until planting) sprouted (held at 12°C until planting – sprouts less than 1 cm – tubers green) and over sprouted (tubers held at 12°C in the dark – sprouts 3-4 cm long). Unsprouted seed took longer to emerge and develop and overall cultivars had fewer stems per plant compared to sprouted tubers.

7.7 Potato Cyst Nematode (PCN)

Posters on modelling and sampling for PCN were presented by B. Boag and D. Trudgill of the SCRI. It was stated that the incidence of white potato cyst nematode (WPCN – *Globodera pallida*) has been progressively increasing so that it is now present in 60% of potato land in England. Infestations do not become detectable until 4 or 5 crops of potatoes have been grown (same land area) and populations of 1 egg per gram of soil are present.

Computer programs have been used to model the dynamics of WPCN levels in the field and to predict the effects on potato yields. This work has shown that WPCN is likely to increase on farms unless resistant cultivars and long rotations (of 5 to 7 years) are used or that 90% control is achieved with nematicides. Granular nematicides were most effective when applied as soon as the problem is detected.

Field studies have shown that current sampling techniques may not detect small foci such as a 20 – 30 cm diameter area of infestation.

7.8 Potato Skin Bloom

Optical techniques to detect blemishes on tuber surfaces, surface water and skin texture are being developed by David Ross of the SAC. Prototypes of a "Bloom Meter" were demonstrated.

7.9 Soil Structure and Rooting

A soil profile pit on the edge of a potato planting was demonstrated by Eric Anderson of the SAC and the effects on nutrient uptake and irrigation scheduling discussed. This showed that 85% of the roots were contained in the top 30 cm of soil although root penetration to 90-100 cm is possible. Root inhibition by soil compaction and dry soil can inhibit canopy development.

7.10 Management Advisory Package for Potatoes (MAPP)

An integrated decision support system for potato growing has been developed by the SCRI and the CD package was released and demonstrated at the field day. At this stage copies were not available. This may be a useful tool to enable growers to test ideas using a "virtual" crop.

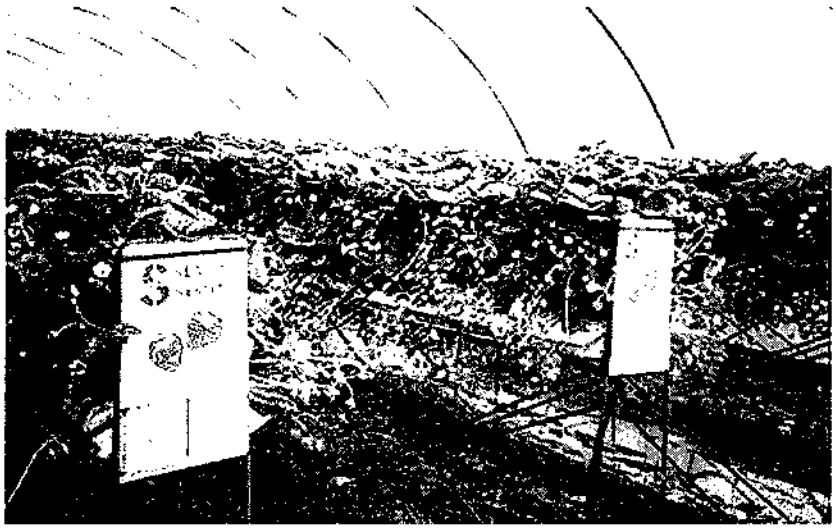
7.11 Brown Rot

The Scottish Agricultural Science Agency is involved with plant health and quarantine with the Scottish Potato seed industry. Details were given on a recent outbreak of brown rot (*Ralstonia solanacearum*) in a potato field and it was traced back to irrigation from the Tay river system. An eradication system has been put in place and infected Bittersweet weeds (*Solanum dulcamara*) removed from the area. Continual surveillance is needed to ensure that the Scottish seed industry remains free of brown rot.

B. SCOTTISH FARM

A unique Scottish farm north of Dundee was inspected. The property consisted of 1200 acres where 250 was planted to potatoes, 50 to strawberries (under plastic), 200 to peas and broad beans and the remainder to cereals. Other enterprises on this farm consisted of a pig unit (900 sows), specialised cereal seed crops, a stock feed business and a recreational trout fishing dam and associated chaletes.

This farmer demonstrated that with good management a number of diverse crops and enterprises could be operated profitably.



Strawberry production – Scotland

C. GRAMPIAN SEED GROWERS CO-OPERATIVE

Storage facilities of the Grampian Co-operative were inspected and these operations discussed by the manager, Archie Puller. The organisation consists of 18 growers with member growing between 16 to 200 Ha each of potatoes and also daffodil bulbs. Over 19,000 tons of potatoes are processed in this facility with 16,000 ton stored as seed the remainder sold as ware crop.

Consulting on machinery, storage conditions, disease control etc. has been allocated to SAC expertise at a cost of £500 per day. Potato tubers are stored in half ton wooden bins and force ventilated with air to prevent condensation.

Bulbs were treated in large tanks and held at 47°C for three hours to control nematodes and other soil borne diseases. Particular emphasis was placed on the hygiene of the storage areas and all surfaces were regularly cleared by vacuuming with large industry cleaners.

D. TAYPAK PROCESSOR

A large processing plant that supplies several different potato lines of potatoes to the large retail group ASDA was inspected. Potatoes were washed, sorted and packed in several different lines within the same packing operation. Tubers were sampled on receival and the quality assessed. Other samples were taken after packaging and kept to induce breakdown. This was done to ensure that the plant produced product within the quality standards required by ASDA.

This plant supplied product to stores in Scotland and Northern England.

8. GROWER'S ADVICE

A number of brochures produced by the British Potato Council (BPC) were obtained at the field day – much of this information is also available on the BPC website – www.potato.org.uk. This is of particular interest where:-

8.1 *Potato Store Hygiene*

A number of steps to reduce losses in store are made. These include vacuuming floors and installing dust extraction equipment over hopper and grading lines.
Power wash or steam clean boxes used to store high quality seed.
Between storage seasons vacuum dirt and debris from floors walls and roof.

8.2 *Black leg risk assessment test*

Seed tubers can be treated for the black leg bacteria by taking tuber sap, incorporating this onto special bacteria growth media and testing with specific antibodies linked to a fluorescent die.
The tests cost £80 + VAT per sample of 50 tubers.

8.3 *Wire worm risk assessment and control*

All the potato varieties were susceptible to wire worm damage. Pherome traps were used to measure levels of the adult wire worm (click beetles) in soil. Adult activity peaked in May (UK). Insecticides Mocap, Phorate and Nemathorin were effective in glasshouse tests.

9. EUROPEAN POTATO GENETIC RESOURCES DATABASE

Information was obtained about a database set up for potato varieties and breeding lines. This resulted from a four year project on Potato Genetic Resources funded by the European Union and involving research institutes, private breeders and non government organisations of eight EU countries and 5 east European institutes.

The database holds over 11,600 entries covering 4,000 cultivars and 1,364 breeding lines with information on pedigree, health status, pest and disease resistance, agronomic and other quality traits.

The database is available on SASA's web page – www.sasa.gov.uk or from Maureen McCreath, SASA, Edinburgh (maureen.mccreath@sasa.gov.uk).

10. ORGANIC FARMING

Brochures on a service to organic farmers provided by the SAC was obtained at the field day. According to this brochure, sales of organic food are increasing quicker than the UK organic farms can supply. Also farm gate prices for organic products are attractive compared to conventional prices. In addition, the EU and the Scottish government have a policy of encouraging farmers to convert to organic and have "additive area" payments for farmers that convert to organic production.

As organic farming is technically more challenging than conventional farming and requires greater management skills and forward planning, SAC provides specialist Organic Farming advisory and consulting staff. A website on this subject is also available – http://www.sac.ac.uk/organic-farming.

11. SEED POTATO PRODUCTION – SCOTLAND

Scotland is a major producer of potato tuber seed in Europe with over 450 specialised growers producing more than 300,000 ton of seed in 14,000 Ha. The industry has developed due to; the cool climate that discourages aphid survival and flight, input from the specialist growers and the Scottish Agricultural Science Agency (SASA) in certifying the crops.

Pathogen free nuclear stock is produced and held *in vitro* at SASA and used to produce mini tubers. Specialist growers usually use hydroponic systems to produce the mini tubers that are then planted in the field and multiplied for 3 to 5 generations. These crops must be grown on land free from potato cyst nematode and potato wort disease. The crops are monitored throughout the growing season and are inspected twice for virus, blackleg and varietal purity. Aphid levels in crops are also measured and if a threshold level is exceeded, further post harvest testing of the tubers is undertaken. Maximum levels of diseased plants permitted in seed at various stages is as follows:-

	Super Elite	**Elite**	**AA**
Leaf roll virus	0.01	All virus	All virus 1
Severe mosaic	nil	0.5	
Mild mosaic	0.05	0.1	
Black leg	0.25	0.5	1.0
Deviation from variety	0.05	0.05	0.1

12. LEIGH MUSTER – TOUR MEMBER PROSPECTIVE (GROWER)

I believe the study tour was a great success and that more producers and people from the industry should have the opportunity to participate in such events. This study tour enabled me to see and learn about different production methods and to see new technologies not used in Australia. Probably more importantly though it enabled me to contrast and compare their industries to our own thereby allowing me to "benchmark" my own enterprise according to what I had seen. This has allowed me to review my production methods and identify practices, which could be done differently and more efficiently. By the same token it has given me more confidence in our own industry to see that producers overseas face similar constraints and pressures as we do in Australia, and in some cases we are able to deal with them more effectively here.

Highlights of the tour

- The larger scale of equipment used in the USA was impressive and the capacity of their handling equipment also.
- To see potatoes produced in different climatic conditions, which only allows a small window of opportunity to carry out tasks, therefore large capacity equipment is required.
- To see an industry where the majority of potatoes are stored in sheds to supply to the fresh market throughout the year- in total contrast to the Australian industry.
- I am relieved that we do not have late blight problems in Australia because most of Europe and America seem to spend huge amounts of time and resources trying to manage the disease.
- Tours through Simplot processing factories and Grand View Feedlot
- To see the contrast between what American consumers want (russeting, longer shaped, not aesthetically perfect) as opposed to Australian consumers. It seems that we have one of the few markets where a premium price is paid for a bright white non blemished washed potato.
- I was impressed by the amount of fresh water available in the USA and the huge network of dams.
- To see that the whole USA potato industry is basically based around one variety – Russett Burbank.
- The European industry seemed to be more similar to ours in Australia. A greater range of varieties, similar sized equipment and washed potatoes similar to those found in Australian supermarkets.
- To see how much Mexican labour is used in USA and how cheap their wages are.

Things I saw that may change my farming practices

- The use of fertigation and chemigation is widespread in the USA. I may use more of this in the future. There may be role for chemical companies to look at how their products perform through chemigation and to get registration for this.
- Saw a field day in Scotland with a Reglone trial where they recommended not to have potatoes under moisture stress when sprayed or it will be taken into the tuber more readily.
- Having pivots connected to telemetry would be excellent in the future but expensive.
- In Australia the certified seed industry needs to become more professional and enforce higher standards such as those in USA ie. Lower tolerances for diseases, more rigid size specifications, overall the industry needs to look at how many generations it is going to allow seed to be kept from. In the USA they can only keep one generation from certified as seed.
- In the USA they use fir bark with Maxim, which may be a good product to use in Australia. In Europe the whole seed industry is based on whole round seed. Very little is cut. I think I will try and use more round seed and request more uniform seed from certified growers.

Technologies

- Overall Australia has very similar technologies to USA and Europe. The USA just does everything on a bigger scale. The Hutterite's level of technology was the best in the world I am sure but out of reach to most commercial operations because they are able to control their labour quality and all work for the common good.
- Variable rate fertilizing was amazing and the air boom fertilizer spreader would be great in Australia if not so expensive.
- The variable output pivot was the most useful technology I saw that would enable us to lift production levels here in Australia. Someone needs to commercialise this.
- Use of infra-red photography to identify wet and dry spots was very interesting and could be used here in Australia.

Australia vs USA & Europe

- USA seems to have less environmental restrictions placed on them than in Australia or Europe. E.g. widespread use of fumigation, a lot of aerial spraying still carried out, few restrictions on water use or monitoring of water returned to river systems. Europe has very tight restrictions/laws regarding which chemicals can be used. Many insecticides and fungicides eg: Chlorothalonil is not allowed to be used in Holland due to environmental concerns. The government very much controls how much farmers are allowed to produce also.
- Potato farms in general were bigger than in Australia with most being of similar size to those found in the Murray, Mallee/Riverina, depending on which part of the USA we were in.

- There seemed to be a similar range of enterprises in the USA to Australia ie some who were just growers, others who were grower packers
- Packing Equipment in Australia is just as advanced as in USA & Europe.
- USA & Europe have a lot more capital invested in Storage facilities
- In some ways USA & Europe producers do not make as efficient use of capital as Australian producers because they have to have such large and expensive equipment which only operates for a short period each year.
- Land values in Europe & USA are higher than in Australia, which makes fumigation & precision farming more cost effective.
- USA seems to produce and consume a lot more processed potato products than Australia
- Chemical costs are cheaper in Australia than overseas
- Potatoes and horticultural products are generally not subsidised as is believed by some Australian producers.
- Some of the irrigation systems used in the US are a lot less efficient than in Australia. Eg: hand shift lines and furrow irrigation. These systems are rarely used in Australia as they are too labour intensive and waste a lot of water.
- Genetically modified potatoes have been taken off the agenda in the US due to consumer backlash and fears of GMO's in general. If Australian producers wish to pursue GM potatoes they must ensure that the benefits to consumers are emphasised, not the benefits to producers.
- I think Australia has to be very aware of the environmental restrictions which could be placed on us from consumers and must be prepared to fight for reasonable outcomes otherwise we may become unprofitable like many European producers.
- The USA has an advantage over Australia in that the Russett Burbank potato is a dual purpose potato and so the second grade material can still be used for processing and some costs can be recovered. In Australia most fresh market varieties are unable to be processed and so more potatoes are wasted.
- The US has better enforcement of quality standards, with USDA officers present within the packing shed to check that product is meeting specifications. Australia needs better enforcement of quality specs. so consumers can have confidence in what they are buying.

Summary

Overall I believe that in Australia we are amongst the most efficient producers of potatoes in the world, because we are in a free market situation, our land is relatively cheap and we are relatively efficient users of our natural resources. Although we may lack some of the economies of scale as the USA, Australian producers are very much in control of their own operations on a daily basis and this can help to minimise waste of resources and loss of control over the business.

13. ITINERARY

July	21/22	Travel to USA – San Francisco
	22	Travel to Boise – Idaho
	23	Simplot – Technical Centre – Caldwell (ID) Gross Farms – Potato production/storage - Caldwell Simplot - Precision Agriculture - Caldwell
	24	Onion production/storage – Parma (ID) Specialized Manufacturing - Onion Harvest and Handling Equipment – Parma (ID) Murakami's onion packing shed Ontario (OR) Skyline Farms – Storage and drip irrigation – Ontario (OR)
	25	Grand View Farms – Beef Feedlot - Mountain Home (ID) Travel to Aberdeen Visit to Idaho Research and Extension Centre - Potato Breeding - Disease Resistance – Aberdeen (ID)
	26	Visit Spudnik – Potato Machinery Manufacturers - Blackfoot (ID) Milestore – Seed cutting and handling equipment – Blackfoot (ID) Idaho Crop Improvement Association – Seed Certification – Idaho Falls (ID)
	27/29	Travel to Washington State - Visit to Grand Coulee Dam (WA)
	30	WHB (Hutterite) – Large production farm – Warden (WA) Simplot Soil Builders – Chemical/Fertiliser stores – Othello (WA) Ag Country – Machinery dealership – Pasco (WA) Hatch's Farm – Onion & Potato Farm – Pasco (WA)
	31	Simplot Vegetable Processing – Pasco (WA) Watts Bros. – Large Commercial Farm – Pasco (WA)

August	1	South Basin Packing - Fresh pack shed Umatilla (OR) Oregon State University Agricultural R & E Center – Hermiston (OR)
	2	Walchli Farms – specialty farm – Hermiston (OR) Travel to Idaho
	3	Travel to New York
	4/5	New York – The Netherlands
	6/7	Plant Research International - Visit Laboratories - Dr. W. Flier Visit facilities of NAR – Inspection Services for Dutch seed potatoes – Dr. T. Kinpers Visit Research Farm of Applied Plant Research - Lelystad – Dr. C. Bus
	8	Travel – to Dundee, Scotland
	9	Potatoes in Practice – Trials and Demonstrations - British Potato Council SAC & SCRI – Dundee
	10	Visit Potato growers, seed merchants and processing plants with Dr. S. Wale
	11/12	Return trip to Australia

14. CONTACTS

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15. ACKNOWLEDGMENTS

- Horticulture Australia
- Wesfarmers Landmark
- Simplot – USA

16. TOUR GROUP

Members who participated in the tour, left to right are:-

Trevor Wicks – SARDI, Adelaide.
Anthony McBride – Grower, Pinnaroo.
Phil Sarasqueta, Bayer Rep, Idaho.
Terry Bayliss – Grower, Robe.
Colin Paech – Grower, Langhorne Creek.
David Rann (Wesfarmers Landmark – Sydney.
Geoff Cox (Wesfarmers Landmark – Melbourne).
Leigh Muster – Grower, Lameroo.
Joe Smith – Grower, Pinnaroo (not in photo)