WA seed potato industry study tour to Holland and Scotland, September 2007

Paul Mattingley
Department of Agriculture & Food Western Australia

Project Number: PT06045

PT06045

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Dr Kristen Stirling

Final Report for Project PT06045
(Project Completion Date: 1 December 2007)

Department of Agriculture and Food Western Australia

WA seed potato industry study tour to Holland and Scotland, September 2007

Final Report HAL Project Number: PT06045

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Purpose of the Report:
Project PT06045 investigated:

- Technologies used in the Netherlands and the United Kingdom for harvest, post harvest treatment and storage of seed potato;
- Systems used in the Netherlands and the United Kingdom for the trading, marketing and exporting of seed potato;
- Seed certification scheme used in the Netherlands;
- Breeding programs and mini-tuber production conducted in the Netherlands and the United Kingdom.

Date of Report: 1 December 2007

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Media Summary and Outcomes

Production of seed potato in the Netherlands is a mature, professional and highly successful industry. There is an opportunity to develop the Western Australian potato industry by understanding and adopting some of the key strengths of the Dutch potato industry. Factors which have helped form the Dutch potato industry as a world leader in seed potato exports are:

- Vertical integration of the supply chain achieved through large companies which coordinate breeding, production, marketing and exporting of seed potato.
- Excellent storage and ventilation systems which provide flexibility for trading.
- Development of varieties which are suitable for a range of climatic conditions and can be marketed and produced around the world.
- Strong global networks and product marketing.
- Exporting of seed by large corporations rather than individual growers which gives strength in procurement, trading and managing supply issues.
- Quality assurance protocols such as sampling of harvested crops for skin defects and diseases and the use of 'hot boxes' to ensure consistency of seed quality.

Examination of the Dutch potato industry also indicates some weaknesses which present opportunities for the WA industry. The Netherlands is facing increasing constraints to production due to environmental, land and disease pressures. To compensate for this the Dutch are outsourcing production of seed to other countries. It would be beneficial to the WA industry to collaborate with Dutch companies to produce seed in WA which could be exported to South East Asia. To facilitate this process it is recommended that:

- A business plan (or revision of existing plans) is developed for the WA seed potato industry so that investors/collaborators can clearly identify opportunities for development.
- A 2 – 3 page brochure is developed on the WA seed potato industry which can be distributed during networking opportunities.

Review of the certification scheme in the Netherlands and the UK indicates that the majority of seed exported by WA is of an earlier generation and therefore likely to have a better health status and so produce higher crop yields. This competitive advantage needs to be better marketed so that clients of Western Australian seed understand how our seed compares to that produced by other countries.

Introduction

The study tour examined the potato industry in the Netherlands and the United Kingdom. During the tour a range of companies involved in all sectors of the potato supply chain were visited. A brief background is provided on the potato industry in each of these countries and a profile on each of the companies visited.

Background on the Dutch potato industry

The Netherlands produces approximately 2.5 million tonnes per year of potato for the processing industry and approximately 1 million tonnes of potato for domestic consumption.

In 2006 894,310 tonnes of seed potato was produced of which 679,440 tonnes was exported and 214,870 tonnes was used domestically. The number of seed growers has reduced from 4000 to 2000 over the last ten years with the average size of farms increasing. Farm size varies from <1 to >150 ha however the average area used for production of seed potato crops is 17 hectares from which growers produce an average of 26 - 30 t/ha. Production of seed potato tends to be specialised with growers focussing on only one type of potato crop. The majority of seed is traded through companies which act both as breeders and exporters. All seed is inspected by the NAK (Dutch general inspection service for agricultural seeds and seed potatoes) to achieve certification.

Seed producers regularly sample their crops to determine when the highest yield in their preferred size range has been reached and to limit the percentage of tubers within the crop which are over-size. Based on this information and the level of aphid pressure they will decide when to de-haulm the crop. Over-sized seed is commonly sold as ware. Seed size specifications for the domestic and export market are: 25/28, 28/35, 28/40, 28/45, 28/50, 35/40, 28/55, 35/45, 28/60, 40/55 mm. With the size range 35-45 mm being most popular.

One crop of potatoes is grown per year with planting occurring in March/April and harvest in September/October. Seed crops are harvested earlier in July/August. Temperatures range from below zero in winter to 25 – 35°C in summer. They have an average rainfall of 760mm which falls throughout the year with slightly more falling in winter.

Up to 300 varieties are commercially available in the Netherlands (licensed and free) but there are only 10 to 15 major varieties having greater than 2500 hectares of seed production. There are more than 200 active breeders of which the main ones are seed companies. They have an intense breeding program which is focused on developing varieties for all climatic conditions. This program is supported by field testing of new varieties under conditions experienced in the Mediterranean and Northern Africa.
The seed potato industry in the Netherlands is facing increasing problems in regards to environmental, land and disease pressures. To assist with this

problem they are increasing production in other European countries such as France.

The majority of producers in the Netherlands have sophisticated ventilation and storage systems which allow them to store product for up to 12 months. Air flow within storage facilities for seed potato is generally set at 125 – 150 m^3/tonne/hr which is substantially higher than the 36 – 42 m^3/tonne/hr recommended in the Australian *Seed Potatoes Best Practice Handling and Storage* manual (Blaesing 2005). Relative humidity is maintained at 95 to 98% and depending on the level of insulation most stores have a cooling capacity of 60 to 80 watts per tonne. Temperature is maintained between 2 and 4^0C.

Harvesting and grading equipment is designed to lift and process large volumes of tubers quickly due to the short (4 to 6 weeks) harvesting period. Producers in the Netherlands appear to be well resourced in terms of machinery however to reduce costs machinery is often shared between producers in close proximity. A number of growers are also starting to work cooperatively with resources such as machinery and labour pooled and run from the one farm. Grading of tubers is usually conducted in storage/shed facilities not on the harvester.

The seed certification scheme allows crops to be grown out to increased generations (up to eight) than that permitted in Western Australia (maximum of five generations).

Consistency in supply of quality export seed by the Netherlands has been achieved in part due to:

- Knowledge of climatic conditions, infrastructure and planting dates in destination countries receiving seed.
- Extensive global networks.
- Technical advisors in destination countries.
- Good transporting techniques such as warming up reefers gradually before they arrive in hot countries.
- Use of ‘hot boxes’ which indicate if tubers are likely to develop rots or break down.
- One company exporting all product not individual growers.

Company Profiles:

Breeding companies:
In the Netherlands there are several corporations which act not only as breeding companies but also as traders, marketers and exporters. These companies range in size with the two largest being HZPC and Agrico.

HZPC – Wichard Sanders (potato breeder) and Arie Westmaas (area manager - Australia)

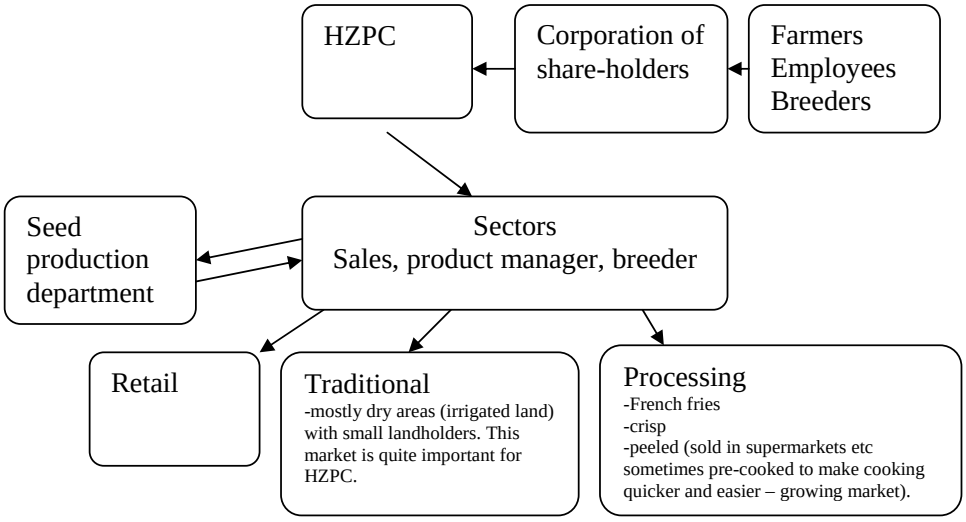
HZPC contracts farmers both within the Netherlands and throughout the European Union to produce potatoes for the seed, table and processing markets which the company merchandises. Initially a grower co-operative, it now exports seed potato globally. HZPC also develops protected varieties and provides agronomic advice to producers on management of its varieties.

HZPC contracts 700 farmers within the Netherlands to produce 400,000 tonnes per year of seed potato. The standard range of varieties grown for HZPC consists of approximately 65 varieties. In addition to their own breeding program they also have 120 affiliated breeders.

The company has 200 employees of which 40 are involved in research and development, 35 are located abroad, 22 are field officers and 85 are in the head office. From last year HZPC has become more sector focussed with employees specialising in particular sectors of the market such as crisp, French-fries, table or seed production. Each sector has a breeder who discusses and develops cultivar profiles in collaboration with clients from within that sector. Each sector also has an agronomist who provides technical support to potato producers.

HZPC cultivates 40% of the 90,000 acres within the Netherlands currently utilised for total potato production (seed, processing and table) and also utilises land within France, the UK, Poland and Canada for cultivation of potato crops.

Company structure:



HZPC conducts research on the production of mini – tubers, screening of new varieties for disease resistance and the development of new varieties. The research station has laboratories for disease monitoring and rents approximately 270 acres from local farmers.

Varieties bred for hotter climates are field tested/evaluated in field locations in the Mediterranean and Northern Africa. Clones are extensively tested in a range of countries. In the field crops are inspected at least twice.

HZPC identified that provision of agronomic advice to support the development of their new varieties was lacking. In response a technical advisor was provided for each sector to assist with the development of management tools.

Within the breeding section there are 15 employees, five of which are involved in the pre-breeding, testing and organising of field trials. There are trial locations in the Netherlands, Europe, North Africa, the Middle East, Canada and the USA. They also test for resistance to common diseases such as powdery scab (*Spongospora subterranea*) and late blight (*Phytophthora infestans*).

The pre-breeding program involves 20,000 seedlings and the commercial breeding program commences with approximately 125,000 seedlings. In addition to their own breeding program HZPC also has 120 allied breeders (who breed varieties for HZPC on their own properties). A select number of share-holder farmers are also contracted to evaluate new varieties on-farm.

HZPC aims to get four new varieties listed per year. If greater than 250 acres of a particular variety is grown for seed than it is considered a success.

It takes 11 years to get a new variety to a commercial stage. This involves:

Year 1	crossing
Year 2	clones in glasshouse
Year 3	positive selection (where breeding lines are selected based on their desirable characteristics)
Year 4 – 7	years of negative selection (where breeding lines are rejected based on undesirable characteristics
Year 8 – 10	field evaluation
Year 11	commercial introduction

HZPC exports seed to a range of clients in the northern hemisphere. In South America, South Africa, China, India, New Zealand, Australia and Canada HZPC sells the breeding rights to its varieties. HZPC has greater than 100 licence agreements within Europe for production of their protected varieties. Within Australia HZPC currently have 13 varieties under plant breeders rights (PBR). Harvest Moon Pty Ltd in Tasmania is the exclusive licensee for these HZPC varieties within Australia while Western Potatoes Ltd owns the WA rights.

All exporting of seed potatoes is conducted in reefers. The majority of transit periods are approximately 14 days (i.e. to the Middle East and Northern Africa). When exporting seed to warmer climates the container is warmed up gradually (over a period of 14 days) from 4°C to approximately 20°C so that on arrival at the destination country it is already sitting at ambient temperature. HZPC provides advice to the transport companies on the best way to transport the seed. It is necessary to warm up the potatoes gradually before they arrive so that they do not heat up quickly predisposing them to rot. Producers in destination countries will plant the seed as soon as it arrives or within 14 days so the tubers must be physiologically ready to plant when transported. All insurance claims are visited by a representative of the company.

Main export countries are Europe and the Mediterranean. HZPC provide technical advice by using offices or agents in these countries. They provide in-house product advice and presentations to these agents in the Netherlands who will then disseminate this information to individual growers back in their own countries. Once potatoes reach the harbour they become the responsibility of the client who must organise the distribution within that country. It is the experience of HZPC that growers who export individually often do not get paid and it is far safer to do it with a much larger corporation. It also means the grower can focus on producing the crop and leave the logistics of selling the product up to HZPC. Markets are not always consistent. i.e. Sri Lanka might want 4000 tonnes one year but in other years they might only want 1000 tonnes. In a big corporation they can better handle the vagaries of demand.
Growers receive approximately 200 to 300 euros per tonne net ($314 – 471 AUD/tonne). All growers receive the same price for product supplied with a plus or minus depending on the difficulty of growing the variety. HZPC have a

very stable grower base as production of seed potato in the Netherlands is viewed as a specialised profession.

Den Hartigh – Jacob Eising and Wim Poland (breeders)

Den Hartigh is involved in the breeding of new potato varieties and the production, trading and exporting of seed potato. They have a 95-98% turnover of their own varieties. The company is primarily focussed on export to the Far East, Northern Africa, Middle East and Central and Southern America. They currently have two varieties in Australia (Eos and Ultra) which are distributed through Elders and have progressed 3 - 4 years through the introductory quarantine period. The majority of regional evaluation trials for these two varieties have been conducted in South Australia and Victoria. The company indicated that they were interested in the potential production of seed potato in Australia for export to South East Asia however they felt it was necessary to confirm the level of client demand for seed prior to commencing this exercise.

Meijer – Leon Mol (managing director)

Meijer is a breeding and trading company focussed on developing a breeding program for seed potato production and on developing varieties overseas. Paul Rennie is currently the agent for their varieties in Australia. These varieties are focussed primarily on the fresh market in the eastern states.

Meijer also produces potato for processing. They have an alliance with Lamb Weston in the US for producing frozen potato products. They have three processing plants in the Netherlands and one in the UK.

A quarter to a third of their seed production occurs in France as it is logistically cheaper and French farmers prefer a French label.

Meijer uses a pool system where all product grown by farmers is pooled and marketed by Meijer. They use one year contracts with the price growers receiving dependent on market price when they are sold. Meijer buy 100% of stock from farmers.

Meijer do not store the seed themselves as the majority of their seed producers have good storage facilities. All bins are labelled so if there is a problem with stock it can be traced back and the producer billed for the cost of seed gone bad.

In 2001 Meijer grew 77,000 tonnes of seed potato which increased to 155,000 tonnes in 2005.

Markets:
Holland 15%
European Union 71%

Asia 5%
Africa 7%
Latin America 2%

Crossing Program:

Year 1	60,000 seedlings
Year 2, 3	regional evaluation in hotter climates
Year 4,5,6	disease selection
Year 7,8	selection based on qualities such as solids, storage quality etc
Year 9	0 - 2 varieties commercially released

For a successful breeding program Meijer believe you need variation and numbers in your basic gene pool plus a few specific goals – you can't breed for the whole market.

They compare with existing varieties to provide technical advice although this will vary from region to region. They provide available information but not advice (only negative points or pit-falls so they can be avoided).

Wash/Packers – Landjuweel (Alex Janssen – Logistics Manager)

Landjuweel wash, sort, pack and transport potatoes for the domestic market in the Netherlands. The company was established in 1922 and is the largest pack house in the Netherlands. One third of all potatoes bought in supermarkets are packed by this company.

Landjuweel pack 1700 to 1800 tonnes of potato per week and 90,000 tonnes of potato are packed per year. The company can process 25 tonnes of potato per hour and do two different varieties at the same time.

The majority of product is sourced from corporations such as HZPC and Agrico however they also use local growers and source product from Spain and Portugal to maintain year round supply.

All potatoes are washed and pre-packed. They don't supply any loose potatoes. Product is usually sized between 35 and 70mm. Potatoes that don't meet quality specifications go to the starch industry.

They do not have formal contracts with growers usually just a verbal agreement. The price packers receive from retailers is decreasing as competition is very strong. They do not have forward contracts with retailers although they are the preferred supplier for one retailer.

The company have specific quality specifications for product coming in. If the load does not meet these specifications it is rejected. Once the load is accepted the grower receives a set price for the load which is based on current market price. From each truck they take 50 tubers before any unloading occurs. This sample is peeled and inspected for defects and starch content. Points are awarded for defects. If the sample receives over 30 points

then the load is rejected. For further quality assurance they take 10 tubers which are stored for 30 days. If there is anything wrong with these tubers then the load it was taken from will be re-called. Numbers are assigned to all loads so that there is traceability throughout the whole system. All loads are also sampled to determine size ranges of the potatoes.

Figure 1: Infra-red machinery used to detect defects on tubers during grading process.

They have two lines for washing and grading which contain infra-red machinery to observe defects which are then sorted out. Since the accuracy is not 100% they still have hand graders as well. Machinery has rubber belts of soft density.

Flevostar Dronten – Jaap Kodde (grower, washer, packer, exporter)

Flevostar produces table potatoes (mostly brushed) for both domestic and export markets. The majority of contracts are to independent stores, city markets and nursing homes with some direct supply to retailers. Approximately 15,000 tonnes of potato are packed per year. Product is sourced from Agrico and neighbouring farms within the Netherlands and also Spain and Morocco so that year round supply is guaranteed. Suppliers are paid according to market prices at the time of sale with no forward contracts. Potatoes are supplied to Flevostar direct from the field with no pre-grading occurring on the harvester. Waste product which can not be packed is used for starch production.

Flevostar focuses on dry brushing of potatoes rather than washing as they believe shelf life is improved and it provides them with a marketing edge. Some washing occurs but this is done in a water bath to prevent mechanical damage to tubers. Potatoes go through pipes for three minutes to dislodge dirt and then go into water baths which use high powered jets and brushes.

The potatoes are packed according to varieties or cooking types with different coloured bags used to differentiate this (for washed potatoes). The brushed potatoes are packed into large hessian bags. Flevostar market product to particular clients using differentiated bags.

Flevostar can store table potatoes for nearly 10 to 11 months. They are harvested in September and kept until June the following year. Kept at 7°C, relative humidity is not controlled as it is naturally high in the Netherlands (around 90 – 95%). When the potatoes are first harvested they are placed into bins and stored in large sheds for two weeks with heaters set higher than the outside ambient temperature to dry them out. They are then stored for another two weeks at ambient daytime temperatures however at night heaters are used to lift the temperature above ambient. After a month they are put into storage until July. Bins are stacked with spaces between stacks to create tunnels. The bins are covered by tarpaulins and fans placed at one end which pull the air through the bins (creating a vacuum effect). The potatoes are treated with a sprout suppressant (CIPC) to stop them from sprouting. Ventilation within the storage sheds is very important.

PPO – Applied plant research (Romke Wustman – project manager)

PPO is the applied plant research arm of the Wageningen University. PPO has a budget of 60 to 70 million euro and employs approximately 500 people.

PPO conducts research on arable crops, green areas and vegetables. They have a range of clients including; government ministries, the European Union, private chemical companies and potato seed companies such as HZPC and Agrico. All projects conducted by PPO are 100% funded by the client. Some government funding is provided for research that is systems based and will be of benefit of all producers. If research is production on-farm based then the farmers levy must pay for it all with no matching contributions from the government.

PPO is moving away from traditional production based research to:

- systems approach research

- expanding internationally and applying new technologies within developing countries
- developing new technologies and products
- legislative driven research such as:
    - the reduction of pesticide use
    - water and nutrient management
- multifunctional agriculture i.e. education and agro-tourism; health and childcare; production, processing and on-farm sales
- peri-urban agriculture
- renewable resources

Paul Struik – Wageningen University

European trends:
Consumers are increasing in Eastern Europe so their wants/wishes are becoming a factor in the market place. Production of potato is increasing in Southern Europe.

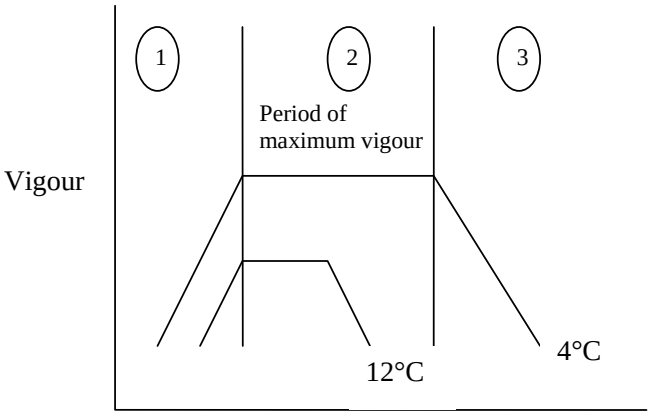
In the Netherlands they have a very aggressive form of late blight (*Phytophthora infestans*) which remains in the soil for long periods of time. When varieties are developed which are genetically resistant to late blight, this resistance is broken quite quickly. Long lasting resistance to late blight can not be developed at this stage.

Instead of transgenic crops which are publicly not very popular a new form of genetically modified crop has been developed. These new products called 'sis–genic' crops develop so that the plant naturally removes the alien genes as it grows.

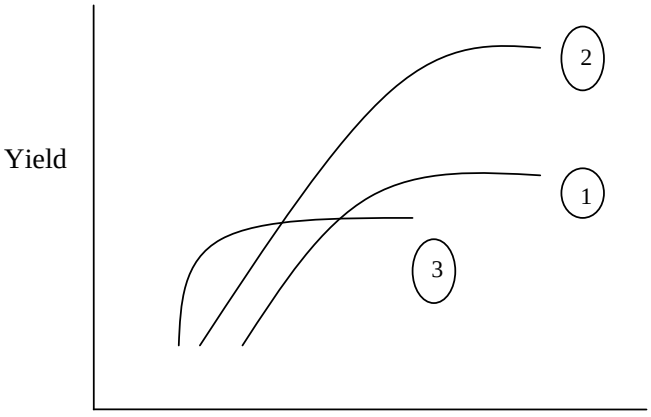
Physiology: *What is the best physiological age to plant?*

Warm up potatoes after cold storage to promote shoot emergence so that they are ready to plant into fields which might be a bit cold. Give more warmth during the first stage of storage (this will shorten the dormancy phase). Don't give more hot temperatures once the tuber has sprouted as you will get fewer sprouts and cause physical damage.

During storage:



During crop development:

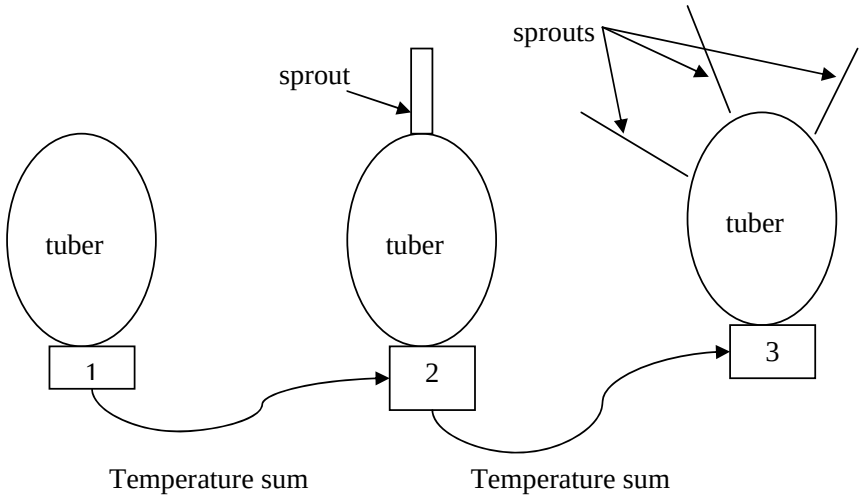


Taking seed out of storage at stage three is better for aphid control as the crop will mature (or reach maximum yield earlier). It will also be better for seed potato production as you get more stems and a greater number of small tubers.

If you want to influence the number of tubers it is better to manipulate through stem number. To get the best number of stems you want to take stored tubers out of storage between the middle and end of stage two.

Genotypes will have different curves and react differently to storage temperatures and therefore different varieties should not be stored together.

Fluctuations in temperature will also result in different curves and therefore seed should always be stored at very consistent temperatures.



Although you can't tell by looking what the physiological age of the tuber is. It should be possible to determine how many day degrees will be required to get the tuber from stage 1 to 3. It should be possible to develop a physiological age index which growers can use to determine the best time to plant tubers for production of seed potatoes i.e. a tuber planted at stage 1 will produce fewer, larger potatoes while a tuber planted at stage 3 will be better for seed production because you will get a large number of smaller tubers. Paul has the theory for this but it needs to be validated under Western Australian climatic conditions.

Irrigation during the formation of the stolons will be critical in determining the number of stems produced. If you irrigate frequently during this period many stems will be produced and therefore many small tubers. If irrigation is less frequent, less stems will be formed. Different genotypes will behave quite differently in terms of time taken to get from stage 1 to 3.

Potatoes like a minor amount of water stress. Tuber size distribution can be manipulated by water and stress.

Current projects:

- Linking molecular analysis with crop physiology to develop crop models. Molecular data will be used to predict how particular genotypes will behave in certain environments and to determine what the perfect genotype is for a certain climate or country. This will assist breeders with determining certain genotypes for certain areas.

- Revisiting photosynthesis using new technology to further investigate electron cycles and modelling the internal activities of photosynthetic pathways.
- Investigating how genotypes develop under low input systems particularly in regards to fertiliser. New legislation means that far less fertiliser can be put onto potato crops. Evaluation of crops under low input systems is occurring in several countries. This information will be used to assist breeders in developing new genotypes which will be suitable for low input systems.
- Investigating and developing a model on the effect of plant canopy and light distribution on the uniformity of tuber size, tuber set and number of tubers.

Oldenhuis and Prinsen - Machinery manufacturers (Lammert Prinsen - owner)

Oldenhuis and Prinsen BV are specialists in agriculture machinery systems. They sell machinery which assists with planting, harvesting, in and outtake storage, sorting, weighing and packaging and palletising systems. They sell machinery throughout Europe and Canada.

AgroVent systems – Gerlof van der Zee (sales manager)

AgroVent is a company specialising in the development and installation of complete storage systems. Design of the system will depend on the quantity of product being stored and whether it is to be stored in bulk or in bins. The variety of potato being stored also needs to be taken into consideration as certain varieties will have particular storage requirements.

For bulk storage (commonly used for processing potatoes) the three following systems can be used:

- Aboveground ventilation with half-round ventilation ducts
- Underground ventilation with grid floor or ducts
- Vacuum suction ventilation under pressure system:

For product stored in bins the following systems can be used:

For drying and ventilating

- Drying wall – in this system the air is forcibly blown through the bins. This allows faster and more effective drying and cooling even in the centre of the bin.

Figure 2: Store room for onions and potatoes designed with a drying wall system.

- Suction wall – a vacuum is created in a corridor between rows of bins forcing air to flow in from the sides of the bin and through the product. This system allows for a very large inlet area and gives proper distribution of air.

For ventilation with outside air

- Longitudinal flow ventilation – the air is sucked in through the ventilator via an inlet hatch. The air is cast across the boxes to the back of the storage area, descends, and flows along the boxes to the outside area. This system is not recommended for hard to store potatoes or for drying produce.

For mechanical cooling

- When mechanical cooling is used the air is blown across the boxes via ventilators and the air distribution tubes to the back of the storage area. The air descends and flows along the boxes back to the vaporiser block. The air is subsequently blown back into the area. Product dehumidification is kept to a minimum due to relatively high evaporation temperature in combination with a large evaporation surface.

When developing the system technical drawings of correct layouts for the various systems and how much product is to be stored are developed. To

correctly design the system the following information is required from the client:

- Bin size (all bins must be of the same dimensions).
- Bin construction i.e. bins must be open (slatted) for storage within a vacuum system or closed if being used in a pressure wall system.
- Number of bins to be stored
- Storage system desired
- How high the bins will be stacked
- Dimensions of existing building
- Varieties being grown

For further information on AgroVent systems please see appendix 1.

Agristo – processors:

Agristo produces frozen French fries and potato scallops. They are a private label company which have one factory in Belgium and one in the Netherlands.

They have one production line which can process 24 tonnes of potatoes to make 12 tonnes of French fries per hour. The factory is open 24 hours and has 100 employees. The crews work in four, three hour shifts. The company produces 120 million kilos of French fries per year (from both factories). They export their product all over the world including Australia (Woolworths is a customer). Raw product is sourced from Belgium, Holland and Germany.

The majority of raw product is sourced from 50 merchants with very little bought directly from growers. This frees Agristo from difficulties in sourcing product and having to provide technical advice to growers

Figure 3: Production line at Agristo processing factory.

NAK – Dutch general inspection service for agricultural seed and seed potatoes (Henk van de Haar – seed policy and inspection systems senior specialist)

The NAK is responsible for the inspection and certification of agricultural crops in the Netherlands. It is an:

- Independent foundation
- Legal basis in National Seed Law and European Union marketing directive (phytosanitory and marketing regulations).
- Under surveillance of ministry of agriculture
- Management of certification schemes:
    - Seed potatoes
    - Agricultural seeds
    - Inspect and certify 70,000 ha of crop

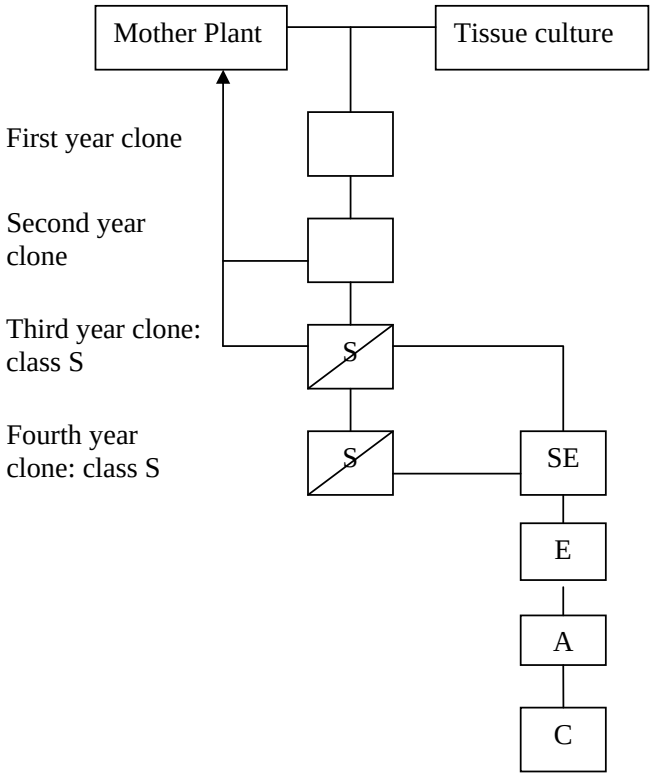
Plant Protection Service (PPS) is responsible for quarantine issues. It has accredited NAK for services such as

- Issuing plant passports (phytocertificate in EU)
- sampling and testing for PCN
- sampling and testing for Ralstonia sol. and Clavibacter m.s.
- export inspections for non-EU countries

The NAK has 228 full time permanent staff, 80 temporary full time staff, 90 full time inspectors and 10 temporary inspectors.

The NAK is a regulatory inspection arm separated from the commercial activities such as EuroGap and food product testing. It is a non profit body which is paid for by fees provided by growers. A board is appointed which must approve activities. NAK-AGRO is a commercial organisation which is allowed to make money and charge for services. NAK-AGRO conducts supply-chain food testing for detection of soil borne diseases etc. Laboratories use PCR testing to detect viruses, bacteria, fungi, nematodes.

Classification scheme:



Class S seed is made from either tissue culture (mini-tubers) or a mother plant using traditional clonal selection. Using traditional clonal selection methods, healthy-looking, high yielding and true to type plants are selected from clone fields which have high standards of health. These plants (mother plants) are harvested separately and propagated as separate clones for a maximum of four years. Seed is tested extensively during the pre-basic phase to ensure health and trueness to type. The Netherlands feel that growers should have the right to do clonal selection if they want. However more growers are moving towards tissue culture because it is an easier process.

SE – super elite (up to gen 5)
E – elite (up to gen 6 (elite 1 and 2))
A – certified seed (up to gen 7)
C - certified seed (up to gen 8)

Clonal selection produces better quality seed (with variety characteristics being closer to type) but it is of a lower weight. Since growers are paid on weight they tend to use mini-tubers. Industry is currently discussing whether seed growers should be paid on tuber numbers rather than weight. This would encourage seed growers to produce quality (numbers) rather than weight.

They would grow crops with less nitrogen, kill crops off earlier and possibly reduce the level of infection from viral diseases. However a minimum weight specification would need to be introduced to ensure that tubers remain at a viable weight.

Inspection system:

- Application
- Field inspection
  - 3 field inspections for tuber borne diseases (viruses and blackleg), trueness to variety, varietal purity and quarantine disease
- Haulm killing dates
  - Haulm killing dates are based on aphid pressure, infection pressure (virus in the field), susceptibility of variety and crop maturity
- Post harvest tests:
  - Viruses (Elisa on PVY, PLRV, PVX, PVS)

Detection of Ring rot (*Clavibacter michiganense*) and Brown rot (*Ralstonia solanacearum*) is achieved using serological tests on excisions from the heel end of the tuber (immunofluorescence). If disease is detected a grower will not be able to grow seed for another 4 - 5 years and his current crop cannot be used.

- Tuber inspection
  - Inspection during grading to NAK standards and import standards for non-EU countries
  - Sampling of adhering soil for PCN
  - Certification

All seed fields must be identified and at least one row not planted between generations. Generally growers either grow all high grades (don't mix SE and E with A and C) or all low grades.

All paddocks before planting must be tested for PCN. If a paddock has PCN no seed crops can be cultivated there.

Irrigation of seed crops with surface water from canals has been banned as brown rot can be spread through water from canals. Seed growers must use bore water instead.

Producers are charged 300 euro ($471 AUD) per hectare for total inspection and certification costs in the Netherlands. These costs are similar to those experienced in WA of approximately $395 – 461 AUD per hectare.

Background on the potato industry in the United Kingdom:

- In 2005 233,527 ha of potato plantings were registered in the UK. From this 5.7 million tonnes of potato were produced. 442,000 tonnes of this was seed with 80,000 tonnes exported.
- The majority of seed potato production occurs in northern Scotland. Fresh potato production occurs in southern Scotland and England due to the warmer climate and reduced presence of stones in the soil.
- The fresh market in Scotland is mainly provided by domestic production. However they do import Egyptian table potatoes at certain times of the year.
- Generally they do not need to irrigate in Scotland.
- Average farm size in Scotland is 300 acres/120 hectares. Most seed producers cultivate an annual crop area of approximately 60 to 100 acres (24ha to 40ha).
- Most farmers practice a 6 year rotation but often this is much longer more like 10 to 12 years. There is currently a big de-stoning program which has opened up a lot more arable land.
- In Scotland the average yield of seed potato would be 14 tonne per acre (35 t/ha).
- April to July/August is the main growing period for seed potato in Scotland. Tubers are left in the ground three weeks after chemical defoliation.
- There are six main packers supplying potato product to the retail market in the UK.

Supermarkets control approximately 70% of potato supply to consumers. There are four major retailers Asda, Tesco, Sainsbury and Morrisons. Independents are disappearing or getting smaller. Supermarkets are starting to want their own exclusive varieties. Several of the varieties that the Higgins Group have bred are now held exclusively by various retailers.

Company Profiles:

Higgins Group – Scotland (David Scott – Export Sales Manager):

The Higgins Group handles the production of over 400 potato growers for supply of product into the processing and table industry. It also has a program for the development of new varieties and the production of seed potato for global export.

Mini – tubers:
Their mini-tuber facilities are located in Northern Scotland. At the beginning of the season they have 90 different varieties in cool store. Production of mini-tubers begins in October/November. Four hundred thousand mini-tubers will be produced this season and are sold for 40 pence ($0.64 AUD) per mini-tuber (WA price is $1.10 per mini-tuber).

The cuttings are grown in the glasshouse for 10 to 15 days to get good root development and are then moved outside to screen houses. This is all done by hand and is therefore very labour intensive.

Three year contracts are now being used for the supply of mini-tubers so that they can predict how many are required. Often they are required to guess from year to year which can make it difficult to provide accurate quantities. They were very short on mini-tubers last year which is why they are now looking for long term contracts. They have started to sell increasing amounts of mini-tubers into the Netherlands as traditionally seed lots are bulked up in the Netherlands by clonal methods (not using mini – tubers).

The Higgins Group also sell a lot of Dutch potatoes in England. They have clients who want English material and clients who want Dutch material. Scottish seed doesn't have viruses whereas quite often Dutch seed does. Scottish seed also tends to have a physiological age advantage. The Higgins Group have strong alliances with the Dutch and currently grow a substantial number of mini-tubers for them. The Dutch may eventually use Scotland to produce seed potatoes for them as well but it will probably be for protected varieties which they have the rights for and can market.

Quality control of seed:

Every crop of seed potato is rogued and once harvested a 20 kg random sample is taken from as many bins as possible. The sample is washed and tubers inspected for any physiological disorders, diseases or mechanical damage. If there is a significant amount of mechanical damage they can relay this information back to the harvesters. If there are particular problems with a sample they will report this back to the grower. The dry matter content is also obtained. Half of the sample is placed into a hot box which is maintained at approximately 25°C at high humidity (100%). Seed is placed into the hot box for approximately 6 weeks to see if any rots or problems occur. The dirt is left on the seed in case there are any diseases present in the dirt. The Higgins Group view this as an 'insurance policy' when exporting seed to overseas countries such as Thailand, Indonesia etc.

Figure 4: 'Hot Box' used to assess the potential of rot and disease development in harvested tubers.

All of this information is gathered to determine if the crop is suitable to be exported and which country it might be most suitable for. Some markets are more sensitive than others i.e. in Turkey they are very sensitive to silver scurf (*Helminthosporium solani*) therefore any crops which have silver scurf will not be sent to Turkey.

The Higgins Group aim to export seed at a size of 35 x 55mm for most varieties however if there are shortages seed will be exported at a size of 35 x 60mm. When particularly short of particular varieties seed as large as 60 x 65 mm will be exported however this is only to markets where seed is traditionally cut such as in Spain.

Seed crops are de-haulmed when the first over-size tuber is observed in the crop. Crops may contain up to 10% of over sized seed although the Higgins Group strongly aim to avoid too many tubers within the crop becoming over sized. Large tubers are mainly sold for processing rather than ware as the skin finish is usually poor due to soil type and damage from grading machinery. The minority of seed producers who do achieve a good skin finish (particularly with varieties such as Nadine) will produce crops with approximately 50% of tubers sized for seed and 50% sized for the ware market. Viruses are generally not an issue so seed crops can be allowed to

grow for longer than those in the Netherlands. In general though the Higgins Group aim to avoid the production of potato crops for dual markets.

Varieties bred by the Higgins Group are evaluated in hotter areas such as Russia where temperatures can reach greater than 40°C. This provides them with a good idea of how they will perform when exported to countries with warmer climates.

Higgins Group – England (David Higgins)

As a merchant they do not see the benefit of being a cooperative. In the UK most cooperatives have disintegrated because of disagreement between founding members. In David's experience cooperatives in the UK don't work.

Their breeding program is aimed at developing varieties for the processing market as they feel there are currently enough companies developing varieties for the fresh market. The breeding program started in 2000 and although they have not been very successful in establishing new varieties of their own they have had some success with other companies' varieties. As they are a processing company they understand the processing industry and offer a fast track for getting new varieties developed and into processing factories. The aim of their breeding program is to have a new variety listed in the European Common Catalogue every second year. They are collaborating with European breeding companies and trialling their new varieties in their processing factories in the UK. They are currently looking for new varieties for the processing market that are pale frying, high in dry matter, high yielding with good drought tolerance. The breeding program can be a bit hit and miss (probably more misses than hits) however they feel that for a company of their size their customers would expect them to be doing research and development in this area rather than just relying on Agrico and HZPC. It also differentiates them from grower cooperative organisations.

Western Potatoes Ltd holds the plant breeders rights (PBR) licence for two Higgins Group varieties (Smile and Horizon). Plant material for these two varieties has been imported into Australia with mini-tuber production expected in the near future once quarantine procedures are completed. Horizon is a new crisping variety which is suitable for hotter countries as it does not require a lot of irrigation and prefers warmer temperatures. Smile is a new table variety which has high specific gravity, red skin, creamy flesh and good taste.

Thailand is quite a big market for the Higgins Group however they are finding it harder to convince growers in Scotland to grow Atlantic because of the low yields achieved. Thailand will be eventually forced to try new varieties as less growers produce Atlantic.

Deleted: poor

The Higgins group see Russia as a huge opportunity due to an expanding market both for production and consumption of processed potato. China could also be a long term opportunity if they were willing to invest a lot of financial and technical support however Russia is a lot closer in location and therefore

more attractive. As Russians become more affluent and westernised they will consume more processed potato products. They are also interested in forming alliances with companies in Russia who want to grow more potatoes. The Higgins Group can provide a lot of support in terms of technical, financial and infrastructure assistance. The west European market is very flat and may actually have a slight downturn in the future with consumption decreasing due to health and diet promotions away from potatoes. Very large processing companies such as FritoLay and McCains can do well in these markets because of their size however for smaller companies it makes no sense to try and compete in these markets. For the Higgins Group it is better to focus on new emerging markets like Russia and China where they can compete on quality and reliability and not just on price.

Grampian Growers – Aberdeen (Archie Pullar)

Grampian Growers are a farmers cooperative comprised of four companies which manage production of seed potato, production of flower bulbs, trading and exporting. The cooperative structure gives the company strength in procurement. Originally producing flower bulbs and strawberries, the production and export of seed potato has only occurred in the last 10 to 15 years. They grow approximately 20,000 tonnes of seed potatoes per year. One third of this is exported to countries such as the EU, North Africa and Israel with the rest remaining in the UK. They know in advance how much is needed each year and approximately what the tonnage will be that they can sell.

Grampian Growers feel that a large part of their success can be attributed to the fact that they had secure markets and good marketing strategies in place when they started as a cooperative. They also felt it was better to do the marketing themselves rather than outsourcing and losing some of their margin. They have a board of directors which meet approximately five times a year.

If the business is sold, whatever amount the grower has put through the cooperative (how much product they have invested) is the share they would receive upon the business being sold. Rather than have dividends each year they feel it is better to re-invest this money back into the company for R&D purposes. This way further development of infrastructure is funded through sales. They don't use a pool system as they feel although this system can be good in a good year it can also hide bad debts. The Higgins Group uses a variety of systems for purchasing stock one of which is a pool system (where all product produced by growers is put into a pool and all producers receive the same price). Generally 10 to 15% of stock is bought on contract from producers. They have very strict quality standards and product not reaching these standards is rejected and they will not source potatoes from that grower in the future (this has happened even to founding members).

Within a 15 mile radius one-third of the growers in the area would produce seed potato for the Grampian Growers. In the wider region they would source

stock from approximately 30% to 55% of seed potato growers. Grampian Growers have retained some of the smaller growers in the area by providing them with infrastructure such as harvesters and storage facilities that the smaller growers need but don't want to invest in owning themselves. The average size of farms in the area would be 60 hectares (ha). Farm size would range from approximately 15 to 300 ha. Most farms would be producing approximately 35 to 37 tonnes per hectare of seed from a total yield of 44 t/ha. Over the last 10 to 15 years the number of farms has decreased and average farm size has increased. Crop rotation is commonly 6-7 years.

Grampian Growers have invested a lot of money in their cool store facilities and ventilation systems. 60% of seed is stored on grower's properties who also have very good storage facilities and 40% is stored at Grampian Growers.

On arrival from the paddock potatoes are dried for 48 to 72 hours as they are often wet. The bins are stacked two high up against a specially designed wall and a tarpaulin placed over the crates so that air can only be drawn from the floor and up out the top. A fan is placed at the top of the wall unit with vents halfway up to suck the air in out of the bins.

Figure 5: Letterbox system used by Grampian Growers for curing of tubers.

The cool store can hold 3600 tonnes and the refrigeration unit can maintain the store at 3°C +/- 0.5°C. Bins are stored two across with a one foot width

corridor running parallel between the crates and the cooling units. Large fan vents are open to exchange air before proper storage commences but once this starts the vents are shut. The doors to the store are opened frequently which exchanges enough air to stop CO_2 building up however if they were building the store again they would have an air exchanger installed. They can store seed potatoes for 12 to 14 months if required. When they first place the potatoes into storage they are left for a week to ten days at 10°C and then over the period of a week the temperature is bought down to 3°C.

They mostly send generation 4, 5 and 6 now although they used to export seed that was older than this. Second generation seed potatoes are initially planted and grown for three generations. Five to six field generations is the average generation of seed being exported.

Crops are irrigated to ensure a good skin finish.

British Potato Council (BPC) – Catherine Lang (Marketing Manager and Dr Mike Storey (R&D Director)

Research:
The BPC was initiated nine years ago and is now being restructured through inclusion of several councils to become a single body covering all vegetables. Their mission is one of fuelling demand (through promotion) and meeting demand (through competitiveness). They are currently investigating methods for improving competitiveness throughout the whole supply chain. Government funding is provided for research into genetics and 'blue-sky' research. The BPC conducts more of the applied research and extension of results within a 3 to 5 year time frame. They consistently look for funding partners to form large scale projects. Draw together a package of funding with supermarkets, chemical companies, private farms, government etc.

- The BPC has a budget of 6 million pounds per year of which 1.2 million is spent on research and development.
- Information gained from the statutory levy is used within the research program.
- Policies on water, waste and soils are government drivers for research programs.
- The BPC does not conduct research on regional projects – must benefit the whole of industry. Main linkages with projects in other countries i.e. Australia, New Zealand and Canada are in the area of disease research i.e. diagnostics.
- Current projects include pest and disease research with particular focus on diagnostics. Late blight is becoming more of an issue in the UK and they are currently developing a warning system via text message.

The BPC have also developed a grower package for minimising bruising of tubers in the supply chain. Recommendations for minimising bruising of tubers during the harvesting operation include:

1. Make sure harvester is well maintained and fit for work. Worn parts or wrongly set up machinery can cause major problems.
2. Try and maintain a low drop height on to a soft surface for elevator to trailer/box transfers.
3. Set haulm removal rollers and guide fingers according to the crop condition.
4. Good maintenance and setting is required of cleaning units, star wheels, finger wheels, spirals and axial rollers.
5. Clod breakers and haulm rakes can do serious damage.
6. Web speeds and agitation. Only use as much agitation as required. Try and keep soil on the primary web and have around 85% fill of the secondary web.
7. Badly aligned shares, diablo rollers applying too much downward pressure, gaps around crop retainers and discs can cause tubers to be crushed and sliced.
8. Web and elevator side gaps. Gaps can cause tubers to be nipped and damaged.
9. Crop susceptibility depends on variety, dry matter content, agronomy, weather and haulm destruction method. Variety differences can be large. The crops should be regularly inspected for damage particularly when changing crops and field.
10. Monitoring of damage levels is essential. If a problem is found be prepared to spend time rectifying the problem, sample at several locations on the harvester and spend time adjusting the machine.

Information provided by Fraser Milne (Scottish Agricultural College). Further information from the British Potato Council on minimising bruising damage of tubers is available from the author (see contact details on page 2).

Marketing:

- The BPC conducts market research on consumer trends by using information from food diaries conducted by 25,000 people over a period of two weeks.
- They aim to educate and influence children about their eating habits before they reach secondary school. They aim to get children excited about potatoes by getting them to grow them etc. Educating children about where produce comes from and how it is grown is currently a big government program to influence their eating behaviour.
- The BPC also aims to influence the packaging of potato products. They aim to market by varieties and include messages on packaging of the attributes of cooking types and health factor.

- In the UK they have moved away from a yield focus to a taste focus and this has helped with marketing potatoes to consumers.
- Crisis management for negative press and issues relating to the potato industry i.e. pesticides, carcinogens in oil used for crisps.
- Research is conducted into understanding the meal repertoire of a typical family (usually 9 to 10 meals)
- Consumer trends indicated that 30 to 40% of all meals in the future will be 'healthy'. There will be a shift to healthy protein such as fish and chicken. There will be an increase in the focus on satiety (i.e. meals not products).
- Potatoes are promoted as 'giving you more' in that they have more vitamin C than rice and pasta and are locally produced so do not have to travel as far (less 'food miles').
- Within the food service industry they aim to get more potatoes on the menu by:
    - Educating student chefs and caterers.
    - Encouraging producers to grow varieties which have better taste rather than higher yielding.

Recommendations and Implications for Australian Horticulture

The Dutch potato industry is a highly professional and well marketed industry that has extensive global networks. The treatment we received as visiting professionals is indicative of the way they have developed these networks. All companies and members of the industry that we visited were extremely giving of their time, open in all matters regarding their business and professional in presentation. It would appear that the Western Australian potato industry could benefit from improving the marketing of its natural environmental advantages and further developing global networks. Recommendations include:

- Developing a business plan (or re-visiting existing plans i.e. Nightingale report 2001) so that potential investors/collaborators can identify potential opportunities for development in the WA seed potato industry.
- Developing a brief brochure that details the current state of the WA seed potato industry, potential development opportunities and the natural environmental advantages of producing seed in WA which could then be distributed on study tours and networking opportunities.
- Encourage collaboration with breeding/trading companies in Europe to produce seed potato in WA for export to south-east Asia. The seed produced under our regional conditions would be of better quality and physiological age than that coming from Europe. In addition the provision of technical advice is an expense for European breeding companies that could be reduced by utilising agronomists in Australia.
- Market our seed certification system better so that clients (particularly in south-east Asia) understand the quality of seed they are receiving. In comparison to the seed certification scheme currently used in the Netherlands our seed is of a younger generational age and this needs to be conveyed to our customers. A simple diagram or photos explaining how our certification system works in comparison to European systems would be valuable tool to improving the marketing of WA seed.

The consistency of WA seed quality could be improved by further developing existing storage and shipping techniques. Techniques used in Europe could be incorporated into our systems.

- Details provided in the company profiles indicate the sophistication of ventilation and storage systems used in the Netherlands. The quality of storage provides them with greater trading flexibility and maintains the quality consistency of their seed. Although their systems are developed more for heating (to dry out wet tubers) and then storage, the systems could easily be developed for cooling. Of key importance is adequate ventilation and consistency of storage temperatures.
- The importance of knowing how seed will be treated on arrival at destination countries and when it will be planted was emphasised by the major breeding companies. This assists them with knowing how and when they should transport the seed and at what physiological age

it should be sent. Consideration should be given to adding critical activities covering the operation of exporting seed potatoes to the Australian *Seed Potatoes Best Practice Handling and Storage* manual (Blaesing 2005).

- The Dutch have developed transporting techniques which ensure that seed sent to warm climatic conditions is less likely to break down or develop rots. An example of this is warming up reefers gradually over a period of 14 days so that on arrival at destination they are already at ambient temperature (20°C).
- Extensive sampling of seed potato crops at harvest enables companies to identify any problems with disease or mechanical damage. Information gained from sampling is used to identify suitable export markets for crops.
- Due to the small size of the Western Australian seed potato industry the use of long term contracts (3 years) would be beneficial to improve consistency of demand.
- The development of a model for physiological development of seed potato under certain storage conditions would assist the WA industry in determining suitable storage periods for seed.
- Samples from harvested crops are placed for six weeks into a 'hot box' set at a high temperature and humidity. Tubers can then be checked for the development of rots or other defects. The potential for tubers to 'break down' can be identified prior to transporting providing exporters with an 'insurance policy'. It would be beneficial if the 'hot box' technique was added to *Seed Potatoes Best Practice Handling and Storage* manual (Blaesing 2005).

The European system of exporting seed through large corporations such as HZPC and the Higgins Group rather than by individual growers provides strength in procurement, trading and exporting. A 'single desk' system can better manage inconsistency of demand and supply and provides some security when dealing with problematic clients. to the small size of the WA seed industry greater exporting strength may be gained by using one company/organisation to export seed.

It may be beneficial for the Australian potato industry to source varieties for all sectors of the market directly from Europe and conduct regional evaluation trials rather than breed our own varieties. The breeding programs conducted in Europe are very successful in developing new varieties for a range of environments and market sectors. This is due to the vast number of crosses conducted per year, well resourced facilities and extensive field evaluation conducted in a range of climatic conditions. Currently our quarantine system makes it difficult and expensive to bring in new varieties from outside of Australia which could make adoption of this type of system problematic.

Collaboration with European breeding companies could also facilitate the introduction of new crisping varieties for the south-east Asian processing market. Currently 'Atlantic' is one of the main varieties grown for the WA crisping market however this variety is low yielding and may be discouraging

new growers from producing seed crops in WA. By facilitating the introduction and developing production of higher yielding crisping varieties it may be possible to encourage new growers to produce export seed crops. New crisping varieties from Europe could be evaluated in target market areas (SE Asia) and those identified as having commercial potential could then be imported into Australia for processing through quarantine. Development of networks with European breeding companies could be achieved by bringing representatives from Europe to WA to view production conditions here and discussing collaborative opportunities in south-east Asia markets.

The capital investment in machinery for harvesting of tubers in the Netherlands is warranted due to the need to lift and process large volumes of tubers over a short period of time. In WA however smaller volumes of product are harvested throughout the year requiring smaller and less sophisticated machinery. As the size of the WA seed industry develops greater investment in harvesting machinery may be required however at this stage machinery utilised for harvesting operations is probably adequate. Handling techniques to minimise bruising have been developed by the British Potato Council (BPC) during a recent research project. Information provided by the BPC project will be assessed and incorporated into a new project conducted by DAFWA and Western Potatoes Ltd which is investigating methods for improving the visual quality of WA ware potatoes to meet consumer needs.

Increasing environmental, land and disease pressure, rising wheat prices and an increase in the production of crops for bio-fuel will reduce the current production base in the Netherlands. This provides an opportunity for increased production in other countries and the possibility of an increase in the world price of potatoes. Greater collaboration with the Dutch potato industry would assist WA by developing knowledge and expertise in seed production and may also provide an opportunity for increased production of seed for export to south-east Asia.

Dissemination of information

Information gained during this study tour will be disseminated to industry through publication of this report and presentation of key findings during an industry workshop at Manjimup held on the 8th of November 2007.

Itinerary

Saturday 8th September
Fly from Perth to Amsterdam depart 4.30pm Perth on MH 0124 arrive KL at 10.10pm
Depart KL at 11.55pm

Sunday 9 September
Arrival Amsterdam Schiphol Airport, flight MH0016 at 6.35am on Sunday 9th September, met by Henk Baarveld

Monday 10 September
9.00-11.30 HZPC research, Mr. Wichard Sanders, 0519-244325 / 06-12966256 (breeder) www.rzresearch.nl, potato breeding / research incl. lunch
13.00 - 14.30 Werkman Uithuizen, Mr. Alex Jansen, potato packaging company, www.landjuweel.nl
Oosternielandsterweg 9, Oosternieland, Tel. 0595 - 454200
16.00 HZPC, headquarters, Joure: Mr. Arie Westmaas, manager Australia, 0513-489888, www.hzpc.nl, potato trading

Tuesday 11 September
8.30 Flevostar, Oudebosweg 14, Dronten, Jaap Kodde, 0321-336272 / 06-53249843, potato trading/growing/packing/storage
11.00-13.00 PPO Lelystad, Mr. Romke Wustman, 0320-291111, Applied Plant Research
- Company profile focussing on Applied Potato Research
- Optimal harvesting, post harvest, storage

14.30 Paul Struik, Haarweg 333, Wageningen, 0317-484246

Wednesday 12 September
8.30 Oldenhuis & Prinsen, Traktieweg 18, Emmeloord, 0527-611648, farm visit, agricultural machinery, www.oldenhuis-prinsen.com, L. Prinsen
11.00 Agrovent, incl. farm visit, storage, www.agrovent.nl, Mr. Van de Zee, 0527-636150
14.00 Den Hartigh, Mr. Jacob Eissing, breeder, agronomist, potato breeding and trading, www.denhartigh-potato.nl

Thursday 13 September
10.00 NAK, Mr. Henk van de Haar, seed potato certification, www.nak.nl

Friday 14 September
9.00 Meijer potato breeding / trading, Rilland, bathseweg 45, www.meijer-potato.com, Mr. Leon Mol + farm visit + lunch

14.30 Agristo, Heieinde 1, Tilburg, www.agristo.nl, 0135-780780, Dieter Raes,+32 (0)56-735050

Saturday 15 September
Regional orientation

Sunday 16 September
Depart from Amsterdam at 3.00pm on KL 1445, arrive Aberdeen at 3.30pm
Pick up car from Alamo/National, drive to Elgin

Monday 17 September
Day at Higgins group farms in Elgin to see potatoes being harvested, graded and cool stored

Contact Ronnie McKay, Higgins Seed - Longhillock Store, Alves, Morayshire, tel 01343 850 700
Evening drive back to Aberdeen

Tuesday 18 September
am - Grampian Growers, Logie, Montrose, Angus, Tel 01674 830555 - contact Mark Clark & Archie Pullar
12.30pm fly from Aberdeen to Humbersie on flight Eastern Airway flight T3753
Taxi to Higgins Group, contact David Higgins, Higgins Agriculture, Greenbank House, Finningley, Doncaster, tel 01302 770591
2.30pm - 5pm meet with David Higgins of the Higgins Group

Wednesday 19 September
am - Train from Doncaster to Oxford, depart Oxford at 8.51, arrive Birmingham 10.36, depart B/ham 11.03 arrive Oxford 12.14
1.30pm - 5pm - meeting with BPC in Oxford - contacts Catherine Lange & Kathryn Race
British Potato Council, 4300 Nash Court, John Smith Drive, Oxford Business Park South, Oxford, OX4 2RT, Tel: 01865 714455
Travel to Earls Court London by rail from Oxford to London Paddington station, then District line to Earls Court

Thursday 20 September
Depart London Heathrow on MH 0003 at 12 noon, arrive KL at 7.25am, depart KL at 9.40am on MH 0125 arrive Perth 3pm on 21 Sept

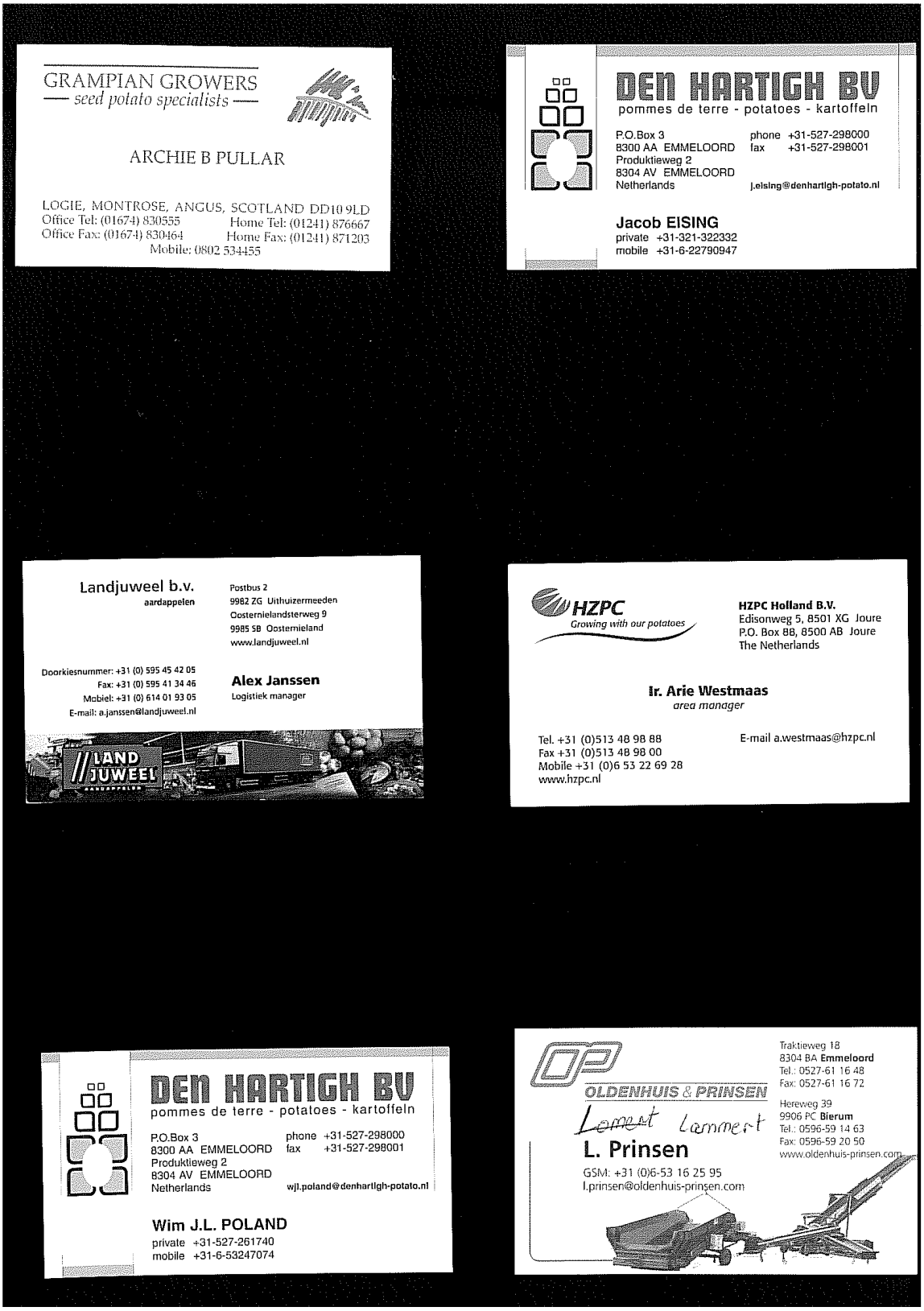
Acknowledgements

The author would like to acknowledge Paul Mattingley and Eerik Schipper (NAO) for organisation of the study tour and Henk Baarveld for his assistance during our visit to the Netherlands.

References

Blaesing, D. (2005) Seed potato handling and storage – implementing best practice. Final Report to HAL for project PT01030. (HAL Sydney)

Nightingale Consulting (2001) Exploiting the South East Asian Seed Potato Market (Manjimup Horticultural Industry Advisory Group)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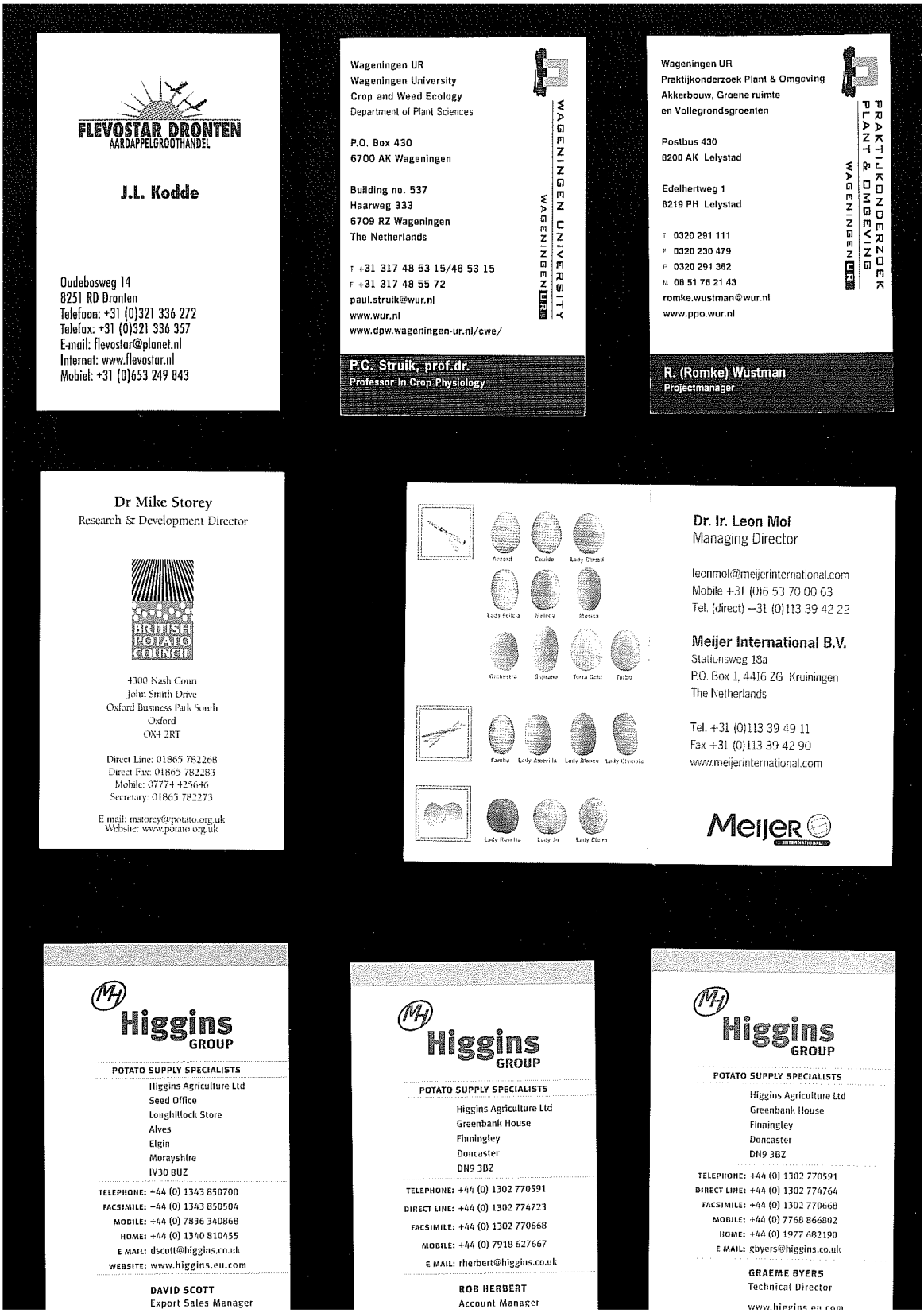

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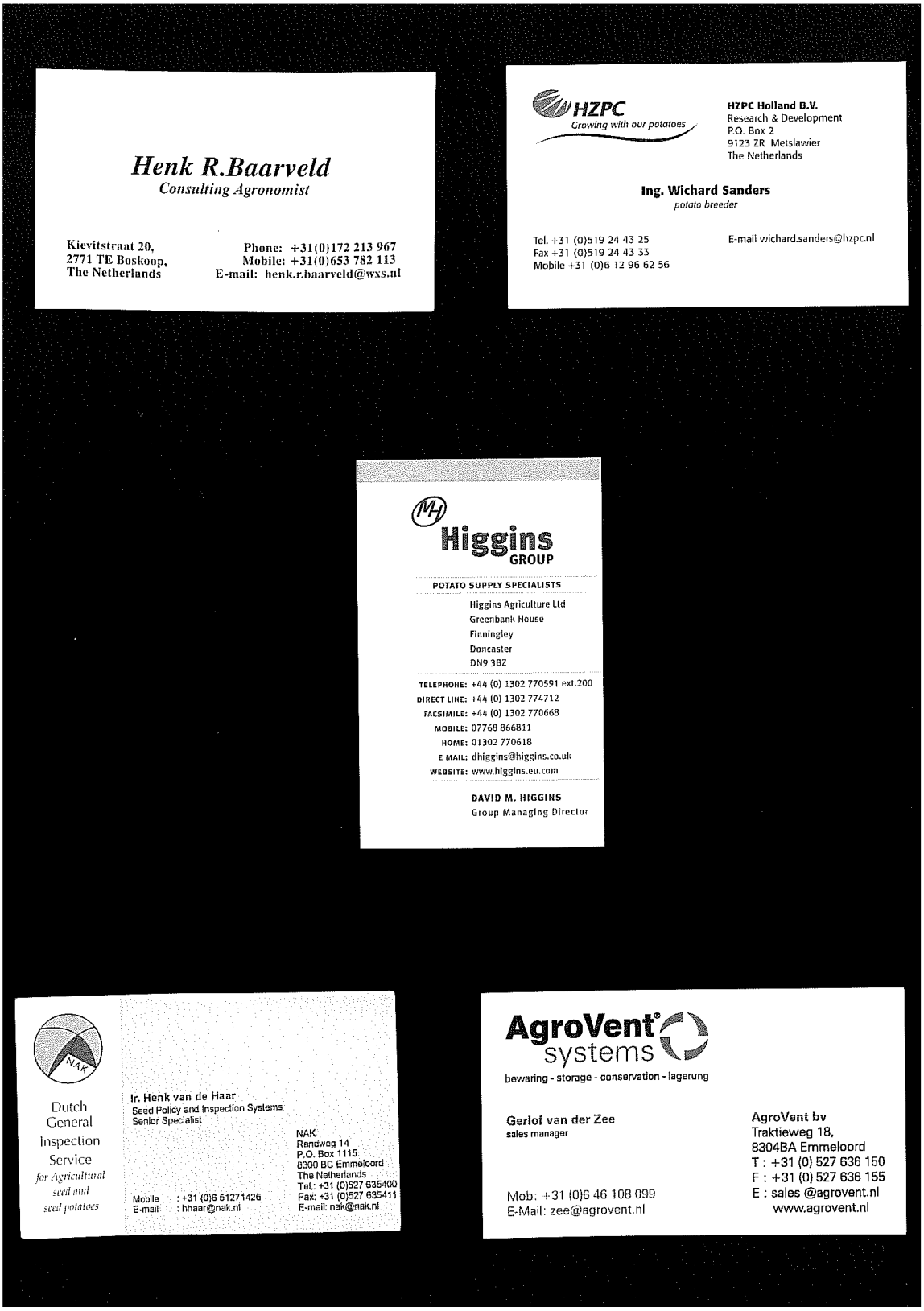

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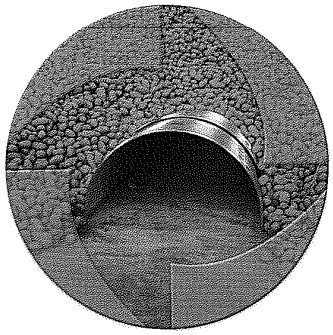
AgroVent B.V.

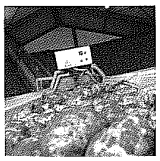


AgroVent is a modern, flexible and dynamic enterprise, specialised in the development and installation of complete storage systems worldwide, adapted to local circumstances and the customer's requirements and growing purposes. Our flexible working methods allow us to quickly and precisely respond to the latest market developments.

As well as designing, supplying and installing your storage system, AgroVent is also concerned with assisting your storage needs on site, training and instruction, and preventative system maintenance. From a simple thermometer to a fully equipped room with digging, storing, grading and packing machinery. AgroVent does it all, with our motto: 'Your crop... Our care!'.

The best system for every situation

Whether you keep your product in bulk or in boxes, AgroVent has always the optimal storage solution. Before you start making plans for storage, it is important to first have an idea about the system to be used. The diagram opposite may help you determine the ideal storage solution for your circumstances.



Your crop.. Our care!

AgroVent is represented all over the world in areas where produce is grown. Customers may contact us directly, although we are seeking collaboration with local, reliable and skilful partners who speak the language and are familiar with the local culture and customs. Knowledge and insight from various angles are translated into better and more efficient products, so that you can leave the care in terms of storing your produce in the hands of AgroVent with confidence. AgroVent can take care of specific matters, but we are also specialised in so-called 'turn-key' projects. We are working closely together with leading suppliers and manufacturers in the agricultural world. One permanent contact point will continually result into good insight, quick interaction and careful price control.

Building a storage room, selecting the right varieties, bringing inside, storing and redistributing, in all cases the AgroVent motto is: 'Your crop.. Our care!'

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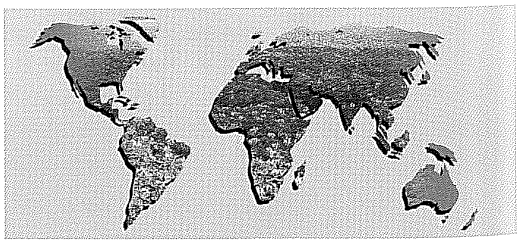
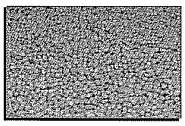


Overview AgroVent Storage Systems



Bulk

YES → Ventilation with pressure room → YES → Aboveground ducts page 4; Grid floor page 4; Underground ducts page 4

NO

Ventilation without pressure room → YES → Aboveground ducts page 4

NO

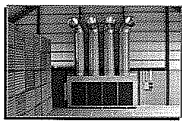
Box storage

YES → Drying → YES → Drying wall page 5; Suction wall page 6

NO

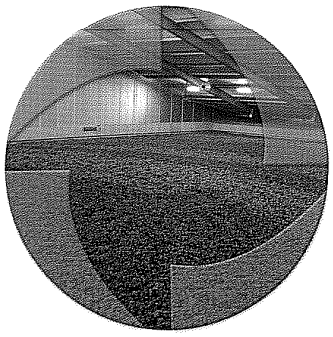
Ventilating with outside air → YES → Airmix units page 7; Combivent page 7

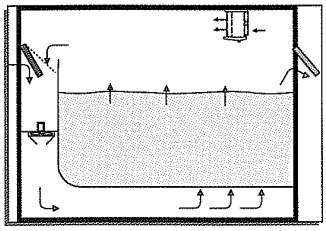
NO



Mechanical cooling

Mechanical cooling → YES → AgroVent Mini block page 8; AgroVent Cropline page 8; Fixed cooling page 8





AgroVent Bulk Storage

The most simple and relatively speaking also the cheapest storage method for your produce is bulk storage. As a rule, more produce can be stored per square foot of room space, while the start-up costs are lower. Select from the following systems:

A. Aboveground ventilation with half-round ventilation ducts
B. Underground ventilation with grid floor or ducts
C. Underpressure suction ventilation

A. Aboveground ducts

Thanks to the gradual transition from a large diameter channel to a smaller diameter channel, the same pressure is maintained in the channel and as a result also inside the product. The centre-to-centre distance between the ducts should be equal to the storage height for the optimal air distribution inside the produce.

Benefits aboveground ducts

- Easy to put in place by one person
- Easy to clean after taking out of the room
- Extra aeration holes for optimal air distribution inside the produce, also at different storage heights
- Less channel damage thanks to larger plate thickness (1.2 –1.8 mm)
- Easy stacking, requiring little storage space
- Lower start-up costs than in the case of underground aeration

B. Underground aeration

Full grid floors provide the most optimal distribution of air throughout the product, as the same amount of air is blown in the entire space and the same back pressure applies. However, the start-up costs are higher than with other systems. As is the case with aboveground ducts, underground ducts must run under a slanting angle for proper distribution of the air. The airflow openings are also adjustable.

Benefits of underground aeration

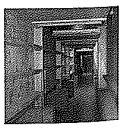
- Optimal distribution of air throughout the product when a grid floor is being used
- Shallower ducts are required (full grid floor)
- Flat floor surface for unloading

C. Underpressure suction ventilation

This system requires the lowest start-up costs in the room compared with the earlier-mentioned systems. However, this system requires more ventilation knowledge because of the large distance the air must travel throughout the product.

Benefits of underpressure suction ventilation

- Lower start-up costs in buildings
- Flat floor surface for taking the produce in and out



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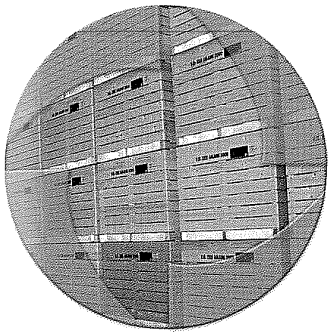
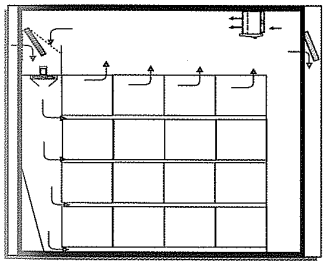
AgroVent Box Drying Wall





Working principle

In this system the air is forcibly blown through the boxes. This will allow faster and more effective drying and cooling, even in the centre of the box.

Conditions for proper working

- Limited number of boxes in a row
- Carefully select the type of box
- Have a slanting pressure distribution wall installed in the box drying wall
- Proper support to the wall of the room is required
- Must be able to partly close off the bottom holesn

Benefits drying wall

- Perfectly separated produce
- Airflow opening can be closed off, allowing more/less intensive ventilation for each row or layer of boxes
- Fast drying and cooling, even in the centre of the box
- Easy to combine with heaters (e.g. for onions)
- Drying, cooling and heating smaller batches is possible
- Either permanent or modular walls
- Faster drying and cooling results in lower energy consumption thanks to fewer running hours

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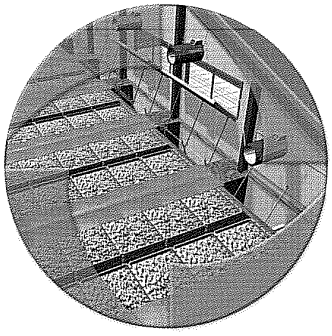
AgroVent Underpressure Suction Wall



Working principle

When creating an underpressure between two rows of boxes, air will flow from the sides throughout the box and the product. This system allows for a very large inlet area and gives proper distribution of air for potatoes as well as for onions.

Conditions for proper working

- There must be sufficient space for inlet and outlet hatches
- Sufficient amount of space above the boxes
- The airspeed must be properly aligned with the system
- Must be able to close off the suction holes

Benefits of a suction wall

- Perfectly separated produce
- Large inlet surface means low air resistance, resulting into lower energy consumption
- The amount of air can be set for each channel
- The air travels over a small distance, resulting into very fast and effective ventilation
- Fast drying and cooling, even in the centre of the box
- All boxes receive the same amount of air, so there are no local dry spots
- Flexible filling the storage area
- System is suitable for many applications

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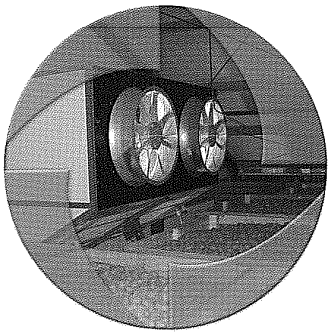
AgroVent Longitudinal Flow Ventilation

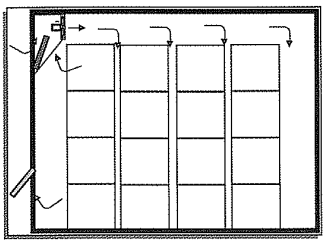


Working principle

The air is sucked in through the ventilator via an inlet hatch. The air is cast across the boxes to the back of the storage area, descends, and flows along the boxes to the outside area. The system is not recommended for hard-to-store potatoes and for drying produce.

Conditions for proper working

- Sufficient amount of space above the boxes
- The airflow may not be interrupted (straight rows and smooth walls)
- Approximately 10 - 15 cm free space between the boxes
- The length of the rows may not exceed 20 m
- The product must be dry when placed in the storage area



Benefits of longitudinal flow ventilation

- Flexible storage system
- Low maintenance
- Can be extended with several more airmix units
- Lower capacity required because of lower back pressure from the product
- Lower start-up costs
- Also to be used in bagged produce storage areas
- Mechanical cooling (Combivent) simply to be integrated in the system

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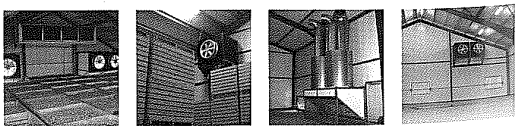

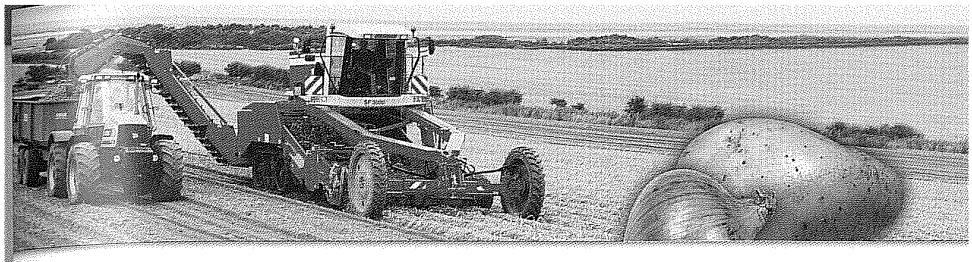

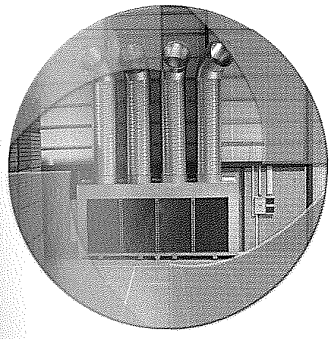

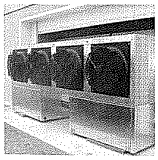

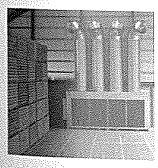

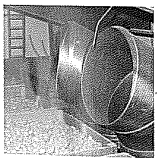

AgroVent (Mechanical) Cooling

Working principle

When mechanical cooling is used, the air is blown across the boxes via ventilators and the air distribution tubes to the back of the storage cell. The air descends and flows along the boxes back to the vaporiser block. The air is subsequently blown back into the area. The units are available as cooling units (mini block and cropline) or as combi cooler only.

Product dehumidification is kept to a minimum thanks to the relatively high evaporation temperature in combination with a large evaporation surface.

Mechanical cooling comes as a stand-alone system or as additional cooling for (outside air) ventilation, for both bulk products and box storage.

Conditions for proper working

- Sufficient amount of space above the boxes
- The airflow may not be interrupted (straight rows and smooth walls)
- Approximately 10 - 15 cm free space between the boxes
- The product must be dry when placed in the storage room
- Power supply must be in line with the required cooling capacity

Benefits cooling

- Faster cooling down to the required storage temperature
- Longer storage period allowed
- Less dependency on weather conditions
- Integrated in storage system by way of storage processor
- Easily sprouting varieties are easier to store
- Reduced weight loss thanks to less breathing

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