PT319
Development and extension of potato hygenic strategies

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Tasmanian Department of Primary Industry & Fisheries

Know-how for Horticulture™

PT319

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Development and Extension of Hygiene in the Potato Industry

By Tony Allwright and Joanne Stagg

Summary

Hygiene standards in the potato industry have been increasing in recent years. However there are some areas still in need of attention. This project addresses two of these areas, hygiene in the storage and cutting of seed potatoes and hygiene associated with machinery movement between properties.
Seed potato cutting contractors and cool store operators were brought together to develop industry guidelines for the cool storing and cutting of seed potatoes. The guidelines were kept practical and achievable while incorporating best practice. The better operators were already following procedures similar to those developed in the guidelines, however, the guidelines have set a uniform standard for the industry. Some operators were operating well below the standard set in the guidelines and they proved difficult to involve in this process. They are being targeted this autumn for training, by one of the processors based on the standards developed in the guidelines.

High levels of soil infection with the onion white root rot fungus (*Sclerotium cepivorum* Berk.), in excess of 400 sclerotia/kg, were detected in some soils. *S cepivorum* was chosen for study as it is readily separated from soil, enabling reasonably accurate determination of the level of soil infection. Cleaning potato harvesters in the field yielded up to 280 kg of dry soil on individual machines. This, combined with high sclerotial counts in soil from infected paddocks, creates the potential for potato harvesters to spread over 100,000 sclerotia of *S. cepivorum* from one infected paddock. Based on this it was considered that machinery should be cleaned to a level where no visible soil remains with medium pressure (3 to 6 bar) cold water. This is likely to minimise the transfer of weed seeds and greatly reduce that of other pests.
Industry guidelines for the cleaning of potato harvesters are to be developed and extended in the coming autumn using a similar method to that employed with the seed cutting contractors and coolstore operators.

Achievement of Project Milestones

The following milestones from the project proposal have been met.

Meetings with industry groups

These have been conducted with the seed cutters and coolstore operators along with the seed grower and commercial grower representatives. Further meetings will be held in the coming autumn with contract potato harvesting operators and growers.

Development and extension of seed hygiene strategy

The seed hygiene strategy has been developed by industry and facilitated by this project. The extension of the seed hygiene strategy has been underway for one year and will continue for the coming season.

Quantifying the risks of soil transfer

Disease prevalence in soil and quantity of soil carried on potato harvesters has been measured and an appropriate level of cleanliness recommended.

Develop and extend harvester cleaning strategy

Recommendations are made on methods for cleaning machinery. Extension will continue in this area in the coming season.

Develop and extend volunteer potato control strategy.

Prepare and conduct farm hygiene courses.

These are being taken up as part of the DPIF Farm Hygiene Team's ongoing program.

DPIF Farm Hygiene Team

A multi-discipline team has been established within the DPIF to develop a major extension program targeting farm hygiene. This is to be a three year project initially, with the following goals-

"To establish 100% awareness of farm hygiene amongst farmers and the public."

"To contain preventable plant and animal pests through the adoption of best hygiene practices, in partnership with industry and the community."

"To promote economic development in Tasmania's rural resources by preventing exclusion from markets due to preventable plant and animal diseases, insect pests and weeds."

"To develop an established and effectively functioning farm hygiene education program in focussed collaboration with private industry and education providers."

"To ensure a mechanism is put in place in the farm hygiene program so that it has ongoing momentum through identifying and communication effectively with both internal and external stakeholders."

The work initiated in this project is to be continued by the DPIF Farm Hygiene Team and the Farm Best Practice Program.

The Farm Best Practice Program, funded by the DPIE, DPIF and Edgell-Birds Eye, is aimed at improving the international competitiveness of processing vegetable growers by maximising their profitability on a sustainable basis, to enable vegetable processors to expand production to meet demand in the growing Asian market.

Seed Potato Storage and Cutting

Introduction

Potatoes are propagated vegetatively with four or five multiplying generations between tissue culture of the nucleus disease free stock and the commercial crop. Although this process is subject to a certification scheme with regular crop inspections, low levels of disease can be present in a seed crop (maximum 2% total visual disease).

A number of diseases can be spread and multiplied during storage and cutting of seed potatoes, particularly dry rot caused by *Fusarium sp*, and this is a weak link in the production chain. To help strengthen this link, the contract seed cutters and cool store operators were brought together to develop guidelines for the storage and cutting of seed potatoes. At later meetings other sectors of the industry were included, consisting of representatives from the processors, seed and commercial growers and DPIF.

Methodology

The guidelines were finalised in the Autumn of 1994 ready for the storage of that season's crop and the cutting of seed for the following season. A copy of the cool store and seed cutting guidelines are contained in Appendix I.

The guidelines have clarified the responsibility of each sector of the industry. They were kept simple and achievable but based on best practice. The specific storage requirements of potatoes were based on the best information available world wide, supplemented with local experience.

After completion of the 1994 planting season another meeting of all participants involved in developing the guidelines was held to allow for their assessment and modification. All participants agreed the process had been beneficial to the industry and that at least one meeting should be organised annually. To achieve this the group decided to establish an ongoing schedule of meetings under the Farm Best Practice Program.

Outcomes

The three potato processing factories in Tasmania, Edgell-Birds Eye at Ulverstone and Scottsdale and McCain's at Smithton all had slightly different size tolerances for seed potatoes prior to cutting and have resisted previous attempts to develop a uniform standard. As a result of this program they have all agreed to develop a uniform standard for the size range of tubers acceptable for use as cut seed and for the weight of seed set pieces.

Uniformity in the size of seed potatoes allow the cutting contractors to produce cut seed of a more uniform size and weight with an even number of eyes per set.

Labelling of incoming boxes of seed potatoes has been with chalk on the side of the box with the information restricted to buyer's and possibly seller's name. The seed cutters and cool store operators decided to trial a new system of labelling boxes of seed consisting of printed cards to be stapled to all boxes by the seed grower with information on cultivar, date of harvest, generation, grower, buyer, cool store, and storage times. This is to be run by the Tasmanian Certified Seed Potato Scheme and a copy of the cards can be found in Appendix II. This information will make seed related problems in the ensuing crop easier to trace back to a cause and will form a necessary part of any quality assurance scheme associated with the potato industry.

The development of guidelines for the cutting of seed potatoes has complemented the increasing commitment to hygiene by the cutting contractors. Most of the cutting contractors are washing their machines daily and the cutting knives between seed lines with medium pressure cold water and in some cases disinfectant on the knives. The level of compliance with the guidelines by the seed cutters has not been determined accurately however it is generally good. Compliance varies between contractors and is also affected by their workload but tends to be less rigorous when cutting small lines of seed. Hygiene standards have improved greatly in the industry in the last two years and with the implementation of a mechanism for further self improvement associated with industry pressure, further improvements are expected. The processors and growers are also putting increased pressure on seed cutting contractors to implement high standards of hygiene.

The industry guidelines for the cool storage of seed potatoes have helped to improve the operation of some of the cool stores and McCain Foods are using the guidelines as the basis of a training course for their cool store operators before the start of the coming season. The guidelines for cool storage of potatoes are based on best practice allowing for the specific environmental requirements required by potatoes for wound healing before cool storage and warming before cutting and planting. The better cool store operators were already using systems that closely resembled those developed in the guidelines. Development of the guidelines was intended to introduce uniformity among the coolstore operators and to obtain a commitment from the less efficient operators to lift their standards. The less efficient operators proved difficult to involve in this process. However they are now being targeted for training by the processors, based on the guidelines.

This HRDC funded project facilitated the development of the guidelines for coolstore operators and seed cutters. Industry is providing the momentum to keep the process moving, resulting in changes in practice.

Harvester cleaning

Introduction

Potato harvesters are recognised as being capable of carrying large quantities of soil due to their size and the nature of their work. This combined with the frequency with which they move about the countryside makes potato harvesters prime suspects in the transmission of soil borne pests and diseases in the vegetable growing areas. Some 60-70% of the potatoes grown in Tasmania are harvested by contract, about 4,500 ha, creating enormous potential for disease transfer.

There is considerable resistance to the cleaning of potato harvesters by a number of the contractors for varying reasons such as the cost, the risk of getting water into bearings in the machine, the time taken to wash a machine. Overcoming these barriers will require an extension exercise followed by farmer education program.

To convince farmers and contractors of the need to wash machinery when transferring between farms, the risk of disease spread by machinery or other vectors needs to be determined, followed by examination of the long term threat to individual industries from particular pests or diseases. Quantification of the risk of disease transfer involved determining the volumes of soil being carried on machinery followed by a risk assessment of the likelihood of there being pests or disease in that soil. Calculation of the costs to various industries involved estimating the potential threat from pests and diseases.

Methodology

Twenty potato harvesters were cleaned as they finished work for the day during the winter of 1994 to determine the quantity of soil being carried. Cleaning involved driving the machine onto a large tarpaulin and use of brushes and scrapers to remove as much of the soil as possible. Once clean the harvester was driven off the tarpaulin, the cleaning's collected, soil separated from plant material, dried and weighed.

Composite soil samples were collected randomly from paddocks known to be infected with the onion white root rot fungus (*S. cepivorum*) and several kg of soil obtained. The soil sample was thoroughly mixed and approximately 200g equivalent of dry soil was sub-sampled for a sclerotial count. Several techniques were trialed for separating white rot sclerotia from the soil including flotation in salt solutions of different densities, sieving with a nest of sieves and combination of both. The technique finally used was to disperse 200g of soil by shaking in 2L of water for 6 hours in an end over-end-shaker and then sieving through a sieve with a screen aperture of 250 μm. Sclerotia of the white rot fungus were collected off the sieve and identified on visual appearance and hardness under binocular microscope. Some fine sclerotia were observed passing through the sieve and no attempt was made to count these although the number appeared to be proportionally small.

Soil cleaned from a harvester in one paddock with a history of club root disease of brassicas, caused by the fungus *Plasmodiophora brassicae* Wor., was used to grow oil seed rape (*Brassica napus* L.) to test for the presence of clubroot. This involved spreading the soil in

trays to a depth of about 75 mm, sowing rape seeds at high density and examining the roots for the fungus after a period of six weeks.

RESULTS

The weights of soil obtained from the potato harvesters are contained in Table I.

Table I

Soil and vegetative material carried on potato harvesters.

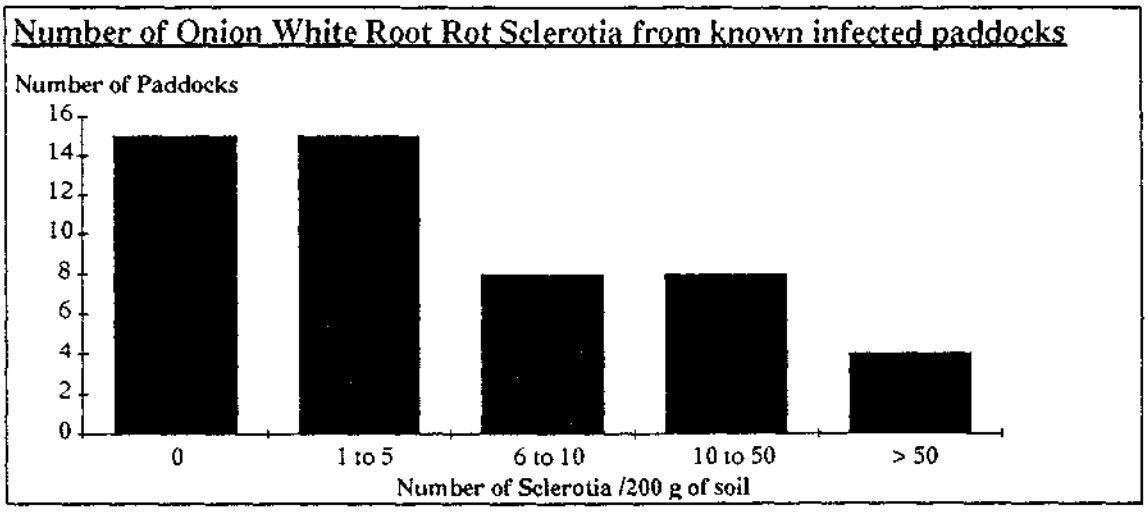
Harvester	Dry soil (kg)	Potato tubers (kg)	Potato tops and weeds (kg)
Wuhlmaus 1033	280	13.5	14.0
Wuhlmaus 1033	152	10.6	4.3
Wuhlmaus 1033	195	22.2	7.2
Wuhlmaus 1433	179	12.3	8.2
Wuhlmaus 1433	83	4.8	13.1
Wuhlmaus 1433	65	6.2	7.9
Wuhlmaus 1433	66	4.7	5.8
Wuhlmaus 1433	112	12.0	3.0
Wuhlmaus 1433	226	8.4	5.4
Wuhlmaus 1433	170	26.0	3.0
Wuhlmaus 1733	281	39.5	18.2
Wuhlmaus 1733	100	30.5	8.0
Wuhlmaus 1733	230	39.0	2.5
Kverneland	141	4.0	12.0
Hagerdoorn	61	9.5	1.5
Hagerdoorn	272	25.7	4.5
Hagerdoorn	263	5.5	4.0
Hilder	79	29.0	7.4
Hilder	154	4.5	1.0
Superfaun	91	0.3	2.0

There was no measurable relationship between soil moisture and the weight of soil carried on a harvester ($r = 0.44$). Machines working in wet soils proved difficult to clean by scraping and greater amounts of soil were observed remaining on these machines.

No attempt was made to quantify the amount of soil carried on different parts of the harvesters. However, visually, the axle assembly carried by far the greatest quantity of soil.

The results from the soil survey to determine levels of onion white root rot sclerotia in infected paddocks are contained in Histogram I.

Histogram I



In most paddocks, the area infected with *S. cepivorum* was close to the entrance to the paddock, with one notable exception being centred around the drainage line from a nearby infected paddock.

The weeds that germinated from some of these samples are contained in Table II.

DISCUSSION

Onion white root rot was chosen for study as the sclerotia of the fungus can be separated from soil and counted relatively easily. The propagules of the common potato diseases such as pink rot (*Phytophthora erythroseptica* Pethybridge), common scab (*Streptomyces scabies* Thaxt), powdery scab (*Spongospora subterranea* Wallr.) and black leg (*Erwinia carotovora* Jones) are difficult to detect and count in the soil experimentally. Onion white root rot has the potential to destroy the Tasmanian onion industry in the next 20 years if unchecked. In concentrating this study on onion white root rot it is assumed that the level of machinery cleanliness that will minimise transmission of this disease will greatly reduce transmission of other soil borne diseases.

In most cases operation of machinery commences at the point it enters the paddock. This is the point where soil and plant material being carried on the machine are most likely to be dislodged. The general concentration of infected areas around gateways into paddocks suggests that machinery has introduced the pest.

The presence of an area of onion white root rot in the drainage line of a culvert is circumstantial evidence for the role of run-off water transmitting disease. As a precaution all run-off water entering the property should be confined to permanently grassed waterways. Fencing of waterways to prevent livestock access is an added safety precaution as livestock are capable of transmitting pests, weeds and diseases both internally and externally.

Sclerotial concentrations of the onion white root rot fungus found in the heavily infested soils suggest that a high level of cleanliness is necessary to minimise the risk of transfer to another paddock. It is considered that no visible soil should remain on machinery after cleaning. For this purpose medium pressure (3 to 6 bar) cold water is considered satisfactory.

The risk of transmitting soil borne pests and diseases is proportional to the level of soil infestation and quantity of soil being transferred. Potato harvesters were chosen for study as

Table II

Weeds Grown From The Onion White Rot Samples.

Property code	47	34	13	32	33	45	37	51	48	46	44	15	49	33	36
Amaranthus powellii S. Wats (Amaranthus)		X											X		
Brassica rapa L. *ssp. campestris* (Wild Turnip)	X	X	X	X						X					
Chenopodium album L. (Fat Hen)					X						X			X	X
Cirsium sp. (Thistle)								X							
Erodium sp. (Storksbill)				X									X	X	X
Euphorbia sp. (Spurge)															
Fumaria muralis Sonder (Fumitory)	X	X	X												
Geranium sp. (Cransbill)															
Grass	X		X		X									X	
Lamiun amplexicaule L. (Henbit)										X					
Lepidium campestre (L.) R. Br. (Field Cress)	X														
Montia fotana L. (Montia)												X			
Papaver sp. (Poppy)		X													
Polygonum persicaria L. (Redshank)												X			
Ranunculus sp. (Buttercup)													X		
Rumex sp. (Dock)				X											
Solanum nigrum L. (Nightshade)		X	X		X			X	X			X			
Spergula arvensis L. (Spurry)													X		
Stellaria media (L.) Vill. (Chickweed)		X	X		X	X	X	X	X	X	X	X		X	X
Trifolium sp (Clover)				X				X				X		X	X

they can transfer large quantities of soil and move between paddocks frequently. Individual paddocks can be harvested in several parts over several months.

The lack of a relationship between soil moisture and the weight of soil carried on a harvester was a little surprising. The wet soils were obviously adhering to the digging webs, the share, tyres and other ground contacting parts. It is probable that the quantity of soil on the axle assembly sufficiently outweighs that from other places on the harvester to mask the effect of soil moisture. The greater quantity of soil remaining on harvesters working in wet soils that could not be removed by hand with scrapers also contributed.

A number of techniques were trialed for the separation of onion white root rot sclerotia from soil including flotation of the sclerotia in a salt solutions and sieving with a nest of sieves, however, these techniques proved unreliable. Krasnozems are strongly structured soils with many of the soil particles bound into aggregates greater than 250 μm in diameter. The strong granular soil aggregates from the krasnozem soils continually blocked the sieves. The technique of shaking 200 g of dry soil in 2 l of water for 6 hours disintegrated the soil aggregates and allowed the resulting suspension to pass through a 250 sieve. This technique, while slow in sample preparation, proved highly efficient for ease of sieving and separation of sclerotia from soil aggregates. Viability of the sclerotia was checked from several sites and found to be high, up to 100%.

Of the weeds germinated from soil samples, amaranthus and wild poppy are threats to the viability of the local processing green bean and poppy industries, respectively. Based on the level of weed seed infestation in the soils' tested and the physical similarity between sclerotia of *S. cepivorum* and weed seeds, the level of cleanliness sufficient to minimise the spread of *S. cepivorum* can be expected to give a similar result with weed seeds.

Extension

The results of the potato harvester cleaning work will be used as the basis for the development of industry guidelines for the cleaning of potato harvesters when moving between crops. The guidelines will be developed in March and April of 1995 using the same process as was employed with the seed cutters and cool store operators. A copy of these guidelines and a report on the extension activities, will be forwarded to HRDC as an Attachment to this report on completion.

A major extension exercise will be necessary to address the concerns of the harvesting contractors if the level of harvester and machinery cleaning is to be improved. The extension program is to be conducted in the coming autumn starting with the development of voluntary codes of practice for the contractors followed by a farmer education program. Farmers must be prepared, and feel empowered, to insist that all machinery entering their property is clean and free of pests and disease. This is a longer term project being undertaken by the DPIF Farm Hygiene Team. Washing facilities are also inadequate or nonexistent on many farms and this is to be addressed by the DPIF Hygiene Team through design of wash down facilities and promotion of tax and other incentives available for implementation of hygiene measures.

APPENDIX 1

Industry Guidelines

For The Cool Storage of Seed Potato

These guidelines have been developed by the coolstore and seed cutting operators in conjunction with seed growers, commercial growers and processors.

Pre-seed harvesting

(Commercial Grower responsibility)

Boxes (½ tonne bins) to be 1170 x 1170 mm (46"x46") made from 150 mm (6") boards with 18 mm (¾") gaps, especially in the floor.

Boxes should have hardwood corner posts and runners.

Boxes must be cleaned and washed to remove soil and debris.

Boxes must be in good condition (i.e. no broken boards or loose nails).

Boxes must be strong enough to stack 6 high in the cool store.

Each load of boxes must have a Clean Bin Declaration correctly filled out and signed on delivery to the seed growers.

↓

Pre-delivery

(Seed Grower responsibility)

Seed to be pre-graded to meet specifications.

Quality Assurance documentations re seed health/quality to be supplied with seed.

Labelling of boxes by seed grower. Boxes labelled by seed grower, including grower name, cultivar, generation, digging date, packing date and seed growers contract number.

Seed dry, soil free, stone free and Tecto treated.

↓

Pre-store curing

(Store responsibility)

Documentation of box information, including date of arrival and date into store.

Curing conditions (10 days between digging or grading and cool storage, before end of April and 15 - 20 days thereafter).

Seed to be ventilated but not covered during curing.

Vermin control.

Inspection

(Commercial grower)

Buyer inspection of seed prior to cool storing.

Storage of seed

(Store responsibility)

Seed to be cool stored immediately following curing.

Cool store temperature to be reduced to 2-4° C after filling.

Cool store to be maintained 2 - 4°C and RH at 85 - 95%.

Arrange boxes to maintain airflow and ventilation.

Monitor RH and Temp daily.

Check tuber temperature weekly.

Maintain drip trays under refrigeration units.

Change air in cool store twice weekly.

Maintain constant conditions regardless of store size.

Store to be sole purpose only whilst storing potatoes.

Meet hygiene standards, that is, removal of soil, limit dust, remove tubers from floor, clean equipment and dispose of refuse promptly.

Maintain general cleanliness in and out of store.

Vermin control

Segregation of seed generations.

Keep records i.e. inventory, coolstore map and environmental conditions.

Removal from store

(Store and commercial grower responsibility)

At the right time: from grower records or as requested, remove seed from store and keep undercover.

Minimize disruption for remaining seed.

Maintain hygiene.

Remap any reorganisation in the store.

Industry Guidelines

For Seed Potato Cutting

These guidelines have been developed by the coolstore and seed cutting operators in conjunction with seed growers, commercial growers and processors.

Pre delivery

(Commercial Grower responsibility)

- Grower to advise store of date of seed removal .
- Under cover storage provided for boxes

Warming

(Commercial grower and cutting contractor responsibility)

- Tuber core temperature to be raised to an ideal temp of 14° C.
- Under cover storage during warming with no draughts and minimal temperature fluctuations
- Vermin control
- Maintain hygiene standards.

Grading

(Cutting contractor responsibility)

- Check obvious disease which could compromise hygiene of operation.
- Grading of tubers to appropriate size grades prior to cutting.
- Remove stones and diseased tubers - at cost to grower.
- Disposal of rubbish hygienically.
- Maintain labelling integrity throughout operation.

Cutting process

(Cutting contractor and commercial grower responsibility)

Maintain machinery and components in good working condition.

Keep knives sharp to limit shatter and feathering.

High pressure wash daily.

Clean and disinfect knives after all seed lines, especially diseased lines

Owner to inspect seed during cutting.

Quality control through regular sampling: 100 sets assessed for damage, rots and size.

Dust seed to grower specifications being aware of occupational health & safety re seed dusting.

Maintain high level of hygiene.

Clean machinery and cutting room thoroughly - minimum daily.

Hygiene - rubbish disposal.

Filling of Boxes

(Cutting contractor responsibility)

Minimise drop into boxes Maximum 100 to 150 mm (4 - 6") to reduce bruising.

Boxes, clean and of good repair to be used..

Do not overfill boxes to avoid damage to seed.

Ensure good ventilation in box.

Maintain labelling/identification of seed

Post-cut curing

(Commercial grower)

Ventilation without draught

Covered boxes/no sunlight

Allow minimum 2 - 3 days for curing prior to planting.

Seed should be dry prior to planting.

Prevent contamination of cut seed.

Prevent any sweating of cut sets.

Seed should be cured before tipping into bulk transport.

Seed should be adequately covered during transport and prior to planting.

Maintain hygiene standards

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McCain

McCain Foods (Aust) Pty. Ltd.

Farm Best Practice

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APPENDIX II

RUSSET BURBANK

GENERATION	FOUNDATION ☐ *tick*	MOTHER ☐ *tick*	CERTIFIED ☐ *tick*
GROWER		DATE HARVESTED	
GRADED ☐ *tick*		TECTO ☐ *tick*	
STORE		DATE IN DATE OUT	
BUYER			