Variety development for the fresh potato market in Western Australia

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FINAL REPORT

HORTICULTURE AUSTRALIA LIMITED

PROJECT PT04023

VARIETY DEVELOPMENT FOR THE FRESH POTATO MARKET IN WESTERN AUSTRALIA

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Purpose of this Report: To present methods and experimental data used to identify new varieties recommended for commercial testing.

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Top to bottom; Auski, Billabong and Delaware Grade 1 samples at Pemberton Packers. The first two varieties were undergoing commercial testing for summer fresh market production. Note their improved appearance compared with Delaware.
Photos: Andrew Taylor, Department of Agriculture, WA.

Contents PT04023

Media Summary

Key components of project

The project aims to improve productivity of the WA fresh potato industry through the development of improved varieties. The varieties are developed by screening breeding lines from the Victorian Department of Primary Industries Potato Breeding Program (VDPI-PBP).

Industry significance

Fresh market variety evaluation is a priority of the Australian potato industry and is overseen by the National Evaluation & Commercialisation Committee for the Fresh Potato Breeding Program (FNECC). The WA industry priority we are tackling is the improved performance of winter grown crops. The yield of these crops is just 60% of the overall average yield for fresh market potatoes in WA. The reduced yield of the winter crop is due to many factors which include storm and wind damage, heavy rain, frost, low temperatures, short days and lack of sunshine.

Key outcomes

The new fresh market variety, White Star, offers improved pack-out, tuber size, disease tolerance and culinary quality and is a good example of the benefits improved varieties can provide. White Star has much higher starch level than Nadine and produces a higher yield of large tubers which will help overcome the excess winter production of small potatoes. These improvements benefit farmers and consumers alike.

The advanced breeding lines Auski and Billabong were tested on a commercial scale for the first time. These breeding lines may provide the industry with and alternative to summer production of Delaware with improved appearance over Delaware and superior cooking quality to Nadine.

Conclusions

Improved potato varieties adapted to local conditions can be produced through this local selection program based on Australian bred potato varieties.

Recommendations for future R&D

- The current system of selecting breeding-lines from a summer planted crop at VDPI-PBP does not suit the selection of winter varieties. In future crosses should be planned that will provide breeding-lines with the characteristics required by the WA potato industry.
- More information on characteristics of progeny from crosses is required to help selection of material.

Recommendations for practical application to industry

- If White Star commercial testing is successful this year (2005) then it should be added to the preferred variety list of the Potato Marketing Corporation of WA.
- If White Star is added to the preferred variety list in WA then future priorities for WA variety evaluation need to be identified. Suitable crosses should be planned in conjunction with the VDPI-PBP to allow the timely production of suitable breeding-lines for testing in WA.

Technical Summary

Nature of problem

The standard potato varieties grown in WA have faults that limit production and marketing. Gains can be made if improved varieties are developed and adopted. Our aim was to select improved varieties for winter fresh market production.

Research undertaken

Breeding-lines were obtained from the Victorian Department of Primary Industries Potato Breeding Program (VDPI-PBP) based at Toolangi. These breeding lines are screened in WA in winter. Breeding-lines already in WA were tested in a winter district trial and in two crisp demonstrations. Three advanced selections for the fresh market were tested successfully on a commercial scale. A quarantine procedure to test tubers for potato virus Y (PVY) was developed to allow potato breeding material from VDPI-PBP into WA.

Major findings & industry outcomes

The new fresh market variety, White Star, offers improved culinary quality and is a good example of the benefits improved varieties can provide. White Star has much higher starch level than Nadine and produces a higher yield of large tubers which will help overcome the excess winter production of small potatoes. White Star produces improved pack-outs for growers. These improvements benefit farmers and consumers alike.

The advanced breeding lines Auski and Billabong were tested on a commercial scale for the first time. These breeding lines may provide the industry with and alternative to summer production of Delaware with improved appearance over Delaware and superior cooking quality to Nadine.

Recommendations

- The current system of selecting breeding-lines from a summer planted crop at VDPI-PBP does not suit the selection of superior winter varieties. More information on the characteristics of the crosses is needed to help with the selection of breeding lines.
- In future crosses should be planned that will provide breeding-lines with the characteristics required by the WA potato industry. The WA potato variety development advisory committee can provide this information.
- Cooking tests of breeding lines selected for WA should be done at VDPI-PBP. Funds for these tests should he provided by the WA evaluators.
- Future priorities for WA variety evaluation need to be identified and suitable crosses should be planned to allow the timely production of suitable breeding-lines for testing in WA.

Future work

Future priorities for WA variety evaluation need to be identified and suitable crosses should be planned to allow the timely production of suitable breeding-lines for testing in WA.

3. Introduction

3.1 Historical Background

This project (PT04023) continues work began in 1989 with HRDC Project PT017 *Potato Variety Evaluation for local, export and processing markets* (Dawson *et al*. 1997). The work continued with Projects PT214, PT515 and PT96017 all entitled *Potato Breeding & cultivar trials in Australia - Western Australia component* (Dawson *et al*. 1998, Dawson & Mortimore 2000). Projects PT214 and PT515 formed part of the National Potato Improvement & Evaluation Scheme (NaPIES) that commenced in 1993. This scheme is based on the potato-breeding program of Agriculture Victoria with evaluation of breeding-lines being carried out in all states. The last two projects finalised were PT00010 *Potato variety evaluation for Western Australia's fresh and export markets* (Dawson & Mortimore 2004a) and PT03070 *Variety development for the fresh potato market in Western Australia* (Dawson & Mortimore 2004b).

3.2 Significance to Industry

Current varieties do not always meet potato purchasers' specifications, which means the industry does not operate to its full potential. An example showing how current varieties do not meet consumer and grower expectations for the fresh market is given below.

The industry priority we are tackling is improved variety performance in winter grown crops. These crops are for September to mid October deliveries and 6,500 tonnes are produced with an average yield of just 26.9 t/ha. The potatoes are freshly harvested from crops planted in April and May. The yield is just 60% of the overall average yield for fresh market potatoes in WA of 44.9 t/ha. It is just 36% of the average yield of the highest yielding times. The reduced yield in for these crops is due to many factors which include storm and wind damage, heavy rain, frost, low temperatures, short days and lack of sunshine. The result is reduced profitability due to small tuber size with many other tubers rendered unmarketable by powdery scab.

If marketable yield can be increased by 5% then, assuming an average return to growers of $500 per tonne, the benefit to growers will be 26.6 t/ha x 5% x $500/tonne x 238 ha = $160,000 per year. The benefits could be expected to accrue over many years during which the variety evaluation project would have moved on to tackle other problems.

Some of these future problems could be the fungal blemish diseases of silver scurf (*Helmithosporium solani*) and black dot (*Colletotrichum coccodes*) that affect the major production areas.

Aim

The project was undertaken to provide superior potato varieties better suited to the requirements of the WA potato industries. In particular we are looking for improvement in winter grown varieties for both the fresh and export crisp markets.

4. Materials & Methods

4.1 Sources of material

Breeding

New varieties were bred by the Victorian Department of Primary Industries Potato Breeding Program (VDPI-PBP) based at Toolangi. 25,000 seedlings are produced annually but only 20,000 produce tubers. All 20,000 are field tested as single plants in the first year and about 1,500 are selected for further evaluation in the second year. These 1,500 lines are grown in short, double-row plots and are selected on the basis of tuber characteristics and cooking tests.

A tripartite number identifies the breeding-lines. For example the advanced breeding-line now known as "White Star" was tested as 97-38-2. The "97" indicates the year the first field generation was planted, the middle number "38" indicates the cross (Gladiator x 91-158-6) while the last number "2" indicates that White Star was the second selection from the first field generation of that cross.

Importation

About twenty new varieties are imported into Australia annually. The imported varieties are also screened at the VDPI-PBP.

4.2 Quarantine requirements for Western Australia

Potato cyst nematode

Western Australia has quarantine regulations that prohibit the importation of potatoes from Victoria. This is due to the finding of potato cyst nematode (PCN) in Victoria. Currently the breeding material is brought into WA under an exemption to this regulation. Conditions placed on the import of the material are that it is accompanied with a declaration that the paddock in which it was grown was tested for PCN and none was detected. The material has then to be dipped in bleach (2% available chlorine for 45 minutes) upon arrival in WA as an additional precaution against PCN. This treatment can burn sprouts of tubers so it is important the tubers are received soon after harvest before sprouting occurs.

Potato virus Y

WA is free from potato virus Y (Holland and Jones, 2005). The breeding lines are tested to ensure only tubers free of the virus are planted. To ensure the seed is suitable for the certified seed scheme in WA the tubers are also tested for PVX, PVS and TSWV using the ELISA technique. PLRV is tested using the stem-print method. Only those tubers with negative virus results were planted.

The material that is grown under this system will enter the WA Certified Seed Scheme as "G2"due to the intensive virus testing done.

Virus testing of breeding lines and other material introduced from VDPI-PBP.

Tubers from VDPI-PBP are stored in a cool sore at 3°C after treatment with bleach. The tubers are placed in the cool store in June. In early October the tubers are removed from cool store and taken to AGWEST Plant Laboratories. For each breeding line all three tubers were

tested. A core is taken from the crown end of each tuber and this is treated with gibberellic acid and planted in individually marked growth cells to allow shoot production. Virus testing is done in groups of three breeding lines: each test comprising three shoots from each tuber of a breeding line with three breeding lines tested together. If a sample tests positive it is possible to re-test the grouped breeding lines individually to determine if any were free of virus.

4.3 Testing sites and planting times

The first test in WA is a summer grown seed bulking to produce seed to plant a winter grown unreplicated screening. This screening is the first activity to select breeding-lines that will address the industry priority to improve performance of winter grown crops. Seed from the first seed bulking is also used to plant another summer seed bulking plot in year 2 to supply seed for the next testing phase.

The next phase of testing is a replicated district trial. This is planted in the major winter cropping area of Perth. Selections from these trials then proceed to a demonstration phase following a further seed bulking.

A disease screening is grown concurrently with the winter grown district trial. This is used to assess field tolerance to powdery scab and a disorder known as crocodile skin. To ensure disease-screening findings are accurate, the disease screening is repeated in the following year for entries selected for demonstrations.

The demonstrations phase has larger plots but these are unreplicated. Farmers and other industry representatives are invited to participate in the selection of varieties at the harvest of the demonstration.

Type, design & size of experiments

Selection of breeding-lines from the Victorian DPI Potato Breeding Program.

Selection of material for testing in WA begins with the second year material grown at the VDPI-PBP potato breeding station. A member of the Department of Agriculture potato evaluation team attends harvest at the VDPI-PBP Toolangi to apply a selection bias suitable for the WA industry. This bias includes selection of oblong varieties for the fresh market, varieties that may be susceptible to late blight which show other promising characteristics (this disease is not present in WA), more textured skin than is acceptable in the eastern states fresh market and crisp varieties for the export market.

Three tubers of each of 200-300 selections are supplied by the VDPI-PBP. Tubers of standard varieties are also obtained from the VDPI-PBP to ensure seed of the standard varieties are of the same generation and physiological age as the breeding-lines.

First seed bulking

The first seed bulking is planted in October in the high yielding seed production area of Margaret River. Three tubers are used to plant two-row plots, each with eight plants at 25 cm spacing between setts. A buffer area between plots is planted with a contrasting coloured variety to prevent "end-plant" effects.

Unreplicated winter screening

Three tubers from the first seed bulking are used for the unreplicated winter screening planted in May in the Perth metropolitan area. This screening allows selection of varieties which perform well in winter. This winter screening is dug in early October to allow selection of material before the next seed bulking is planted at the end of October.

Second seed bulking

Selections from the unreplicated screening are grown in a second seed bulking planted at Margaret River late in the following October. Plots are two rows by 3.6 m having 36 plants on average. The 60 cm of row between plots is planted with a buffer variety having tubers of contrasting colour to separate the plots. The use of two row plots is effective and economical as it eliminates "half" the edge effects. A twin row digger is used at harvest. Sufficient seed is now available to plant the district trial and have spare seed for further bulking. For the district trial the seed is shed-stored. For the October seed bulking at Margaret River seed is cool-stored.

District Trial

The trial is planted in a commercial crop. Two row plots, as described in replicated screening above, are used with three replicates being planted. About 30 entries are tested each year.

Third seed bulking

Selections from the district trial are grown in a third seed bulking planted at Margaret River late in the following October. Methods used are as described for the second bulking above.

Demonstration

Varieties selected from the district trial are next tested in a demonstration which allows district trial results to be confirmed. It also allows growers and industry representatives to participate in the evaluation of the varieties.

The demonstrations are planted in commercial crops. Unreplicated double row plots 15 metres long are planted. Mostly six to 12 varieties are tested. We name most of the breeding-lines before they are tested in demonstrations to allow easy identification. We have found that the breeding-line serial numbers were confusing and difficult to memorise.

A field day is held when the demonstrations are harvested. Farmers and industry representatives are asked, at the start of the field day, to inspect the unlabelled, harvested plots which are laid out on the ground. They are asked to vote for their top three varieties using a simple 1, 2, 3 vote. All votes are used to determine the industry's favourites. First, or "1" votes are multiplied by 3 then tallied. Second, or "2" votes are multiplied by 2 then tallied. Third votes are simply added to give a final ranking of votes. Subsequent discussions can then concentrate on the most popular varieties. On-farm testing is the best way to get adoption of new varieties. Varieties selected from the demonstrations will then be tested in a commercial phase.

Commercial tests

The aim of the commercial tests is to confirm the yield and quality results from the district trials and the demonstrations. These tests also allow the new variety to be challenged with

the commercial handling practices of mechanical harvesting, bulk transport, washing, packing and retail sales.

Two commercial crop locations are chosen to allow the consistency of performance to be assessed. Each farming enterprise is supplied with 500kg to 3 tonnes of seed, depending on availability. This is enough seed to plant a quarter to one hectare at each site. The planting was done in consultation with the Potato Marketing Corporation of WA and Western Potatoes Ltd who have arranged to have the production from these sites assessed for yield and pack-out.

Consumer tests

Western Potatoes Ltd has also conducted consumer reaction to new varieties undergoing commercial testing. Test potatoes are displayed in a specialty fruit and vegetable store as well as in a major supermarket store.

Customers are told that a new potato variety is being tested. A survey questionnaire asks customer's opinion of the appearance, what they consider is important when judging appearance. Customers are also given cooked samples of the test potato, and a standard for comparison, and asked for comments about the taste of the potatoes.

4.4 Selection criteria

We want to identify varieties that will provide benefits to growers and consumers.

For the fresh market we specifically want to identify higher yielding varieties for winter production that have tolerance to powdery scab and poor weather. Late maturing breeding-lines may not be suitable for the short season of winter production. Resistance to PCN is desirable. Culinary quality must be versatile with good boiling quality. Frying quality should also be acceptable.

A future priority for new varieties for the WA industry is likely to be blemish tolerant varieties for summer production to complement Nadine. Here varieties with resistance to blemish diseases (silver scurf and black dot) are required. The varieties must also have low (score of 2 or less) after-cooking-darkening. Versatile cooking quality is also required. At present it is not possible to predict which crosses may have the desired blemish tolerance.

When large scale French-fry processing ceased in Manjimup in 1999 we decided to evaluate only those French-fry varieties that could also be used for the fresh market. This means that any new varieties selected require cooking quality and appearance acceptable to both fresh market and French-fry processors.

For the crisp market we want improvements in yield and quality over Atlantic. Main quality factors are shape, eye depth, specific gravity, fry colour and internal disorders. Light fry colour and high specific gravity from the cold soils of winter and early spring harvest are also required. Successful crisp production in this period will allow more processing of fresh tubers, rather than stored tubers, plus increased export to processing factories in Asia.

Selection criteria are also discussed with the results of each experiment.

4.5 Measurements

Growth characteristics

Dates when 50% of plants emerged, closed in row, matured and broke dormancy are recorded. Dormancy is assessed by noting when 3 out of 5 tubers, stored under sacks in a shed, have shoots 3 mm long.

Tuber characteristics

At harvest a tick sheet of tuber characters is completed. Skin colour and texture, eye and heel depth, shape and size and uniformity of same, plus faults and disease reaction is recorded. Tuber characteristics are assessed as being suitable, questionable or unsuitable for the market requirements.

Wash pack quality

A sample of 25 tubers is harvested from the demonstration by hand 2 weeks after maturity of that variety, hand washed and packed in plastic bags for two weeks in the dark at room temperature. The tubers are assessed weekly for; skin bloom, percentage of marketable tubers, amount of rots and amount of shooting. This allows selection of varieties that tolerate washing and storage and maintain their appearance in the market chain.

Disease resistance screening

Powdery scab tolerance is measured in a dedicated powdery scab trial was introduced during the seventh series of fresh market trials using the method of Genet and Braam (1995). This is planted on an infected site in a commercial crop. Five replicates of four plant plots are used. From each plot tubers >30g are washed and the surface area affected on each tuber is assessed using the following scale:

a) nil,
b) slight (up to 5%),
c) medium (5-25%)
d) severe >25%.

The severity score is calculated from the equation:

$$\text{Severity} = \frac{(b \times 1)+(c \times 2)+(d \times 3)}{a+b+c+d}$$

Entries are tested in two consecutive years in order to confirm the results.

Grading for yield

The grades used vary with market type and are shown in Table 4.5a. Where varieties for several markets are tested in the one trial fresh grading standards are used.

Table 4.5a. Grades yield assessment by market type.

Grade	Market type	
	fresh market	crisp
chats	0- 70g	0-50g
small	70-120g	50-80g
medium	120-350g	80-300g
large	350-450g	300-430g
oversize	>450g	>430g
marketable*	70-450g	50-430g

*Marketable yield was classed as the small to large grade and this was called Grade No. 1 for the fresh market trials.

Internal disorders

For the unreplicated winter screening and the district trial 10 tubers from each plot is assessed for internal disorders. Tubers are cut in half and the number affected by fleck, hollow heart, vascular stain or other disorders are recorded. For demonstrations 50 tubers are assessed.

Specific gravity

A 4 kg sample is used to determine specific gravity using the weight in water weight in air method.

Cooking

Fry colour

Crisp

This test shows which varieties produce acceptable frying colour for both the crisp, French-fry and fresh markets. Five tubers from each plot are tested. Three unpeeled tubers are cut in half longitudinally and two transversely. One half of each tuber is discarded. Slices about 2.2 mm thick are prepared. The first slice from the remaining halves is also discarded, and the next four slices are cooked to give 20 crisps per sample. The crisps are fried straight away (less than 2 minutes exposure to air) in cottonseed oil at 180°C until bubbling ceases. Crisps are placed in the oil individually to prevent them sticking together. The crisps are then drained and scored for colour using a scale of 1 - 10 shown in Table 4.5b. Oil is changed after 90 frying tests.

Domestic French-fries

Fresh French-fries for domestic use are cooked for assessment by Western Potatoes Ltd at the demonstration stage. French-fries are prepared from three tubers and fried at 170°C for 5 minutes, cooled then re-fried at 190°C for 3 minutes. Overall colour of each French-fry is scored on a scale of 1-7 with 1 being white and 7 being dark gold. A score of four or less is acceptable. {This scale equates to the American French fry processors' 000,00,0,1,2,3,4 colour chart, 000 and 00 scores are acceptable in the plant after one minute frying while scores of 0 and 1 are acceptable after full frying in the plant and at home (i.e. about 3'45" frying time in all)}.

Boiling tests

3 tubers from each plot are boiled until soft when tested with a skewer. The tubers are scored for colour, after-cooking-darkening (ACD), sloughing and mash quality. Mash quality is assessed for one of the boiled tubers. This tuber is mashed to a creamy texture and the riciness, or lumpiness, of this mash is assessed by rubbing mash between thumb and forefinger. These tests are done immediately after cooking except for ACD which is assessed after tubers are cold. Details of scoring scales are shown in Table 4.5c.

Demonstration tests

For the fresh market, Western Potatoes assess samples which are cooked at the of Agriculture, WA potato laboratory at Bunbury. Tests are as above but a microwave and taste test is added.

Microwave and taste test

Two tubers of about 200g are tested individually. The tubers are washed, dried and there skins pricked. One tuber is placed in a Western Potatoes microwave capsule (*Potato Microwaver*). This is placed in a 750-Watt microwave oven set on high for 2 minutes. The capsule is then turned upside down and microwaved for another 2 minutes to give a total cooking time of 4 minutes. The second tuber is then cooked. After cooking the tuber is removed from the oven and left to stand for 1 minute. The tubers are assessed by cutting in half longitudinally. A knife is used to check for evenness of cooking and evenness of texture. One half of the tuber has its flesh roughed up with a knife to see how it flakes up. The evenness of texture and flakiness are used to give a score of 1 to 4. 1 is "not recommended", 2 is fair, 3 is good and 4 is excellent. The flaking of the flesh also releases aroma which can be assessed.

The tuber is also assessed for taste (Slater *et al.* 2005).

Table 4.5b. Fry colour score sheet used in cooking tests.

Crisp fry colour test			French-fry colour test		
Range	Score	Description	Range	Score *	Description
Too light	1	White	Acceptable after 1 minute (') frying for frozen product	1 (000)	White
↑	2	Very light yellow		2 (00)	Very light yellow
Desired colour	3	Light yellow	Acceptable after 3'45" frying for frozen product	3 (0)	Light yellow
↓	4	Yellow	↓	4 (1)	Yellow
	5	Light gold	Acceptable after 5' + 3' frying for fresh product	5 (2)	Light gold
Borderline for crisps	6	Gold	↑ too dark	6 (3)	Gold
Borderline for French fries	7	Dark gold	↓	7 (4)	Dark gold
↑	8	Brown			
Too dark	9	Dark brown			
↓	10	Black			

* American French fry colour chart score shown in brackets

Table 4.5c. Boiling tests, scores and descriptions.

Test	Score	Description
Flesh colour	1	White
	2	Creamy white
	3	Cream
	4	Deep cream
	5	Yellow
Greying and after cooking darkening	1	Nil
	2	Slightly grey
	3	Moderate, greyish black
	4	Marked blackening around eyes and/or stem end
	5	General blackening
Disintegration and sloughing	1	Nil, surface smooth and translucent
	2	Slight, surface dull but mainly intact
	3	Moderate, major part of surface sloughed off but mainly intact
	4	Severe, floury mass
	5	Severe, soupy
Riciness after mashing	1	Nil
	2	Slight
	3	Moderate
	4	Marked

4.6 Statistical analysis

Data from replicated experiments is analysed using analysis of variance. Genstat® statistical software is used and residuals are graphed to determine the validity of the analysis. Where significant effects occur, means are separated from those of the standard variety using the least significant difference method.

An "arcsin" transformation of disease data is used when distribution of raw disease-index is skew. Transformation formula = (asin (sqrt(disease index/100)))*180/pi.

5. Results

5.1 Selection of breeding lines from VDPI-PBP 2005

5.1.1. Background

The priority for variety improvement in the WA potato industry is improved winter performance. Varieties should perform well in short, cold days. Tolerance to powdery scab and resistance to potato cyst nematode are other desirable characteristics. Specific gravity should be greater than Nadine with an arbitrary target of greater than 1.060.

Crisp breeding-lines that might produce well in winter are also required for the export market in fresh crisp potatoes. High yield and light cooking from cold soils are required.

The prospect that White Star will fill the WA potato industry's requirements for an improved winter variety (Dawson & Mortimore 2004b) means that new priorities may need to be considered. This priority is likely to be an alternate summer variety to Nadine. It will have to have improved cooking quality but similar appearance with some tolerance to the blemish diseases, silver scurf and black dot. Therefore selection of breeding lines should also include versatile cooking quality and good appearance for summer production. Low after-cooking-darkening levels are also required as the soils of the major summer production area at Manjimup and Pemberton are conducive to the development of this fault.

5.1.2. Selection of material from VDPI-PBP 2005

5.1.2.1 Selection criteria used at VDPI-PBP for WA selections

The aim is to select the most suitable potato breeding-lines for testing in WA. The selection plots at VDPI-PBP are grown over summer and so under completely different conditions to winter production in WA. This makes selection for WA winter production on field performance in Victoria difficult. To overcome this disadvantage, parent-characteristics of the crosses were used in an attempt to predict which breeding-lines may produce the most suitable material. This material should grow well in winter and be tolerant of powdery scab and potato cyst nematode. It should also have versatile cooking qualities. The progeny from potentially suitable crosses was selected in a more lenient manner. We reduced the emphasis on tuber characteristics, as these are likely to differ when grown under winter conditions, but put more emphasis on parent characteristics.

The other selection criteria discussed in Section 4.4 also apply.

5.1.2.2 Generation 2 selections 2005

This material is in its second field generation and is grown in *Selection Plots*. About 1,500 breeding-lines were planted for the crisp, French-fry and fresh markets. Breeding-lines were being selected for inclusion into the following year's *Junior*, or generation 3, trials. Selection by the breeder is based on tuber characteristics, maturity and cooking quality.

Selections for WA include fresh and crisp material with a high chance of PCN resistance and good winter performance. Breeding lines with low ACD with suitable skin and shape for the fresh market with tolerance to blemish disease are also selected.

Selections for the crisp market are shown in Table 5.1.2.2a. 44 crisp breeding lines were selected from 12 crosses by staff from WA and the VDPI-PBP. Of these cooking data was available for 31 breeding lines. When cooking performance was taken into account the selections were reduced to 35. Those lines with specific gravity less than 1.088 and fry colour less than 7 were rejected. Note that selections chosen solely for WA-only were not cook tested at the VDPI-PBP.

Selections for the fresh market are shown in Table 5.1.2.2b. 196 crisp breeding lines were selected from 50 crosses by staff from WA and the VDPI-PBP. Cooking test data was available for 119 of these breeding lines. When cooking performance was taken into account the selections were reduced to 122. Those rejected had specific gravity less than 1.060, fry colour greater than 8, or ACD greater than 2 or sloughing greater than 2. Note again that selections chosen solely for WA only were not cook tested at the VDPI-PBP.

Other selections are shown in Table 5.1.2.2c. Twelve breeding lines from 10 crosses were selected. These were mainly French fry types that had outstanding tuber characteristics and were considered to be worth testing in WA for the small French fry industry. After cooking data was considered, 11 were selected for further testing.

Table 5.1.2.2a. Crisp selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Colour	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			>1.087	<7							
Standard variety											
Atlantic 1	M	WA	1.097	6	3	2	3	c+			
Atlantic 2	M		1.092	5	3	2	3				
Campbell 14 x 69-32T-4 (crisp)											
01-3-3			1.083	4	3	1	3		c		no, low SG
Wontscab x Trent (crisp)											
02-67-29			1.085	5	2	1	2		c		no, low SG
Atlantic x 89-33-1											
03-1-2	M	WA	1.103	5	3	2	3	c	c	short oblong sl russ of skin	yes
Atlantic x Kamai											
03-3-2	ME	WA	1.087	5	2	1	2	c+	c	sl EB, good shape	no, low SG
03-3-3	VL	WA	1.096	6	2	1	2	c	c	large bush	yes
03-3-5	L	WA	1.104	6	3	1	2	c	c	large bush, sl flat, sl russet	yes
03-3-6	VL	WA	1.109	5	5	1	2	c	c	large bush, good shape, sl russet, golden fry colour	yes
03-3-7	ME	WA	1.085	5	2	1	2	c	c	sl russet	no, low SG
Clone 82 x Astra											
03-4-1	ME		1.094	5	1	1	1	c?		sl EB, deep heel	yes
03-4-2	M	WA	1.099	5	1	2	2	c?	c	sl oblong - small	yes
03-4-6	ME	WA							c		yes
03-4-8	M	WA							c		yes
03-4-10	L	WA							c	HH large bush	yes
03-4-11	ME	WA							c	sl EB	

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2a continued. Crisp selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			>1.087	<7							
Standard variety											
Atlantic 1	M	WA	1.097	6	3	2	3	c+			
Atlantic 2	M		1.092	5	3	2	3				
Clone 82 x Crispa											
03-5-5	M		1.085	5	1	2	2	c+	c	even shape and size, v good smallish	no, low SG
03-5-15	ML	WA	1.100	4	1	2	1	c+	c	round good yield	yes
03-5-16	M	WA	1.086	6	2	1	1	c	c	round, good shape, sl flat	no, low SG
03-5-18	L		1.097	5	2	1	2	c?		large bush, lrg size	yes
03-5-22	ML	WA	1.104	6	1	2	3	c	c	clean, sl sprouting, bit flat, lrg no's	yes
03-5-23	L		1.106	4	3	1	3	c		lrg no's	yes
03-5-24	ME		1.091	3	2	2	1	c		sl EB, high nos	yes
03-5-25	ME	WA							c	sl EB 2 late R	yes
03-5-26	L	WA	1.109	5	2	1	2	c+	c	good shape	yes
Comet x Dawmor											
03-6-2	ML	WA	1.100	4	4	1	3	c+	c	good shape, size	yes
03-6-4	ML	WA	1.098	4	4	1	1	c	c	good size, sl heel	yes
03-6-5	M	WA	1.088	2	2	3	2	c?	c	sl flat	yes
03-6-6	ME	WA	1.091	6	3	2	2	w	c	sl flat	yes
03-6-8	M	WA							c		yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2a. continued. Crisp selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			>1.087	<7							
Standard variety											
Atlantic 1	M	WA	1.097	6	3	2	3	c+			
Atlantic 2	M		1.092	5	3	2	3				
Comet x 93-6-3											
03-7-3	M	WA	1.102	5	4	1	3	c	c	HH largish bush, cream flesh	yes
03-7-4	M	WA							c		yes
03-7-5	ME	WA							c		yes
03-7-6	M	WA							c		yes
03-7-9	M	WA							c		yes
03-7-10	M	WA	1.086	4	3	3	2	c	c	low no's	no, low SG
03-7-15	ML	WA	1.098	5	2	3	2	c+	c	gd shape and no's	yes
03-7-18	M	WA							c		yes
03-7-21	L	WA	1.101	5	4	2	1	c+	c	gd shape	yes
03-7-22	ML	WA	1.114	4	4	4	3	c+	c	HH, v high DM%, cream, gd shape	yes
03-7-25	M	WA	1.100	4	4	1	2	c?	c	yellow cream, hollow	yes
03-7-27	L	WA							c	HH	yes
Lady Rosetta x ND 860/2											
03-17-1	M	WA	1.096	3	3	3	1	c?	c	sl EB, needs to cook well b/c shape, deep eyes & heel	yes
Orion x Dawmor											
03-21-7	M		1.075	7	2	1	1	w		Fleck/ high t no, v ev shape, size m, deepish eye heel, sl text	no, low SG
03-21-10	ML	WA	1.088	4	3	2	2	c+	c	gd shape	yes
Umatilla x 96-141-12											
03-41-04	ME	WA							c, w	sl netted ware & crisp	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	Boiling tests‡ ACD	Boiling tests‡ Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban	L		1.080	6	1	1.5	2				
Delaware	M		1.075	7.5	2	1.5	1				
Desiree	ML		1.089	6.5	4	2	2				
Ruby Lou	M		1.082	5.5	2	1.5	1				
Agria x 91-158-6 (ware cross)											
02-1-1	VL	WA	1.091	6	5	1	2			Extras v.large bush	yes
Crystal x BF 15 (ware)											
02-12-2	M	WA	1.066	10	1	1	2	w+	w	w sm, r thickish, m-sh eye and heel	no, dk fry
Crystal x Coliban (ware cross)											
02-18-2			1.085	5	1	1	2				yes
Desiree x Norland Wisc Super Red											
02-21-7			1.083	8	4	1	3				no, slough
88-59-12 x Knox (crisp/ware/F fry?)											
02-73-4			1.075	6	3	1	2		w		yes
Nadine x Coliban											
02-37-3			1.064	10	1	1	2				no, dk fry
02-37-7			1.074	10	1	1	1				no, dk fry
02-37-10			1.061	10	1	1	1				no, dk fry
02-37-14			1.065	10	1	1	1				no, dk fry
Sebago x Shine											
02-53-1			1.083	5	1	1	3				no, slough

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
92-19-10 x Katahdin											
02-86-4			1.088	7	1	1	3		w		no, slough
Crystal x 93-37-3											
03-9-1	ME	WA							w		yes
03-9-2	ME	WA	1.076	6	1	1	2	w?	w	gd boiling, low yd	yes
03-9-4	ME	WA	1.072	7	1	2	1	w+	w		yes
03-9-6	ME									sl EB	yes
03-9-7	ME		1.079	6	1	2	2	w+		gd skin	yes
Ida Rose x Ruby Lou											
03-12-3	M	WA	1.087	6	2	1	2	g'met	w	magenta skin, white flesh	yes
03-12-4	ML	WA	1.078	6	1	1	1	w+	w	sl EB, gd skin and shape	yes
03-12-8	ME	WA	1.072	7	3	2	1	g'met	w	dark pink, shallow eyes, low yld	yes
Crystal x 97-77-2											
03-13-4	ML	WA	1.091	6	1	2	2	Ff+	w	gd shape, gd yield	yes
03-13-6	ME	WA							w	EB	yes
03-13-9	M	WA	1.094	2	3	2	2	Ff+	w	sl flat	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Kipfler x 93-37-3											
03-16-6	E	WA							w	EB	yes
03-16-7	VL	WA							w		yes
03-16-9	ME	WA	1.080	7	2	2	1	w	w	sl EB, elongate, gd skin	yes
Lady Rosetta x ND 860/2											
03-17-1	M	WA	1.096	3	3	3	1	c?	c	sl EB, needs to cook well b/c shape, deep eyes & heel	no, ACD >2
Mondial x Maris Piper											
03-18-1	M	WA							w		yes
03-18-2	M	WA							w		yes
03-18-3	M	WA							w		yes
03-18-4	M	WA	1.087	7	4	1	2	Ff?	w	bit wide, short, sl flat & tapered	yes
03-18-5	ML	WA							w	Good flesh, poor skin	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Delaware 2	M		1.075	7.5	2	1.5	1				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Nadine x 93-37-3											
03-19-1	ME									v small bush	
03-19-2	ME	WA	1.057	9	1	1	1	w+	w	v gd skin	no, low SG
03-19-3	ME	WA	1.053	10	1	1	1	w+	w	ATTRACTIVE, good skin oblong	no, low SG
03-19-4	M	WA	1.057	10	1	1	1	w+	w	v gd skin	no, low SG
03-19-6	ME	WA	1.057	10	1	1	1	w	w	sl EB/ gd size, sl lenticels	no, low SG
03-19-7	L	WA	1.081	6	2	2	1	w	w	large bush/ large	yes
03-19-8	M	WA	1.064	7	2	1	1	w+	w	1 late purple stem R (from prev plot)/ gd skin	yes
03-19-9	ME	WA	1.065	7	2	1	1	w+	w	gd shape, lenticels	yes
03-19-10	M	WA	1.067	10	1	2	1	w	w	slight fur, round	yes
03-19-11	M	WA	1.057	9	1	1	1	w+	w	gd skin, gd yield	no, low SG
03-19-12	ME	WA	1.058	10	1	2	1	w+	w	sl EB/ gd skin, yld	no, low SG
03-19-13	M	WA	1.056		1	1	1	w+	w	gd boiling, good yld & skin	no, low SG
03-19-14	M	WA							w		yes
03-19-15	ME	WA							w		yes
03-19-16	ML	WA	1.063	10	1	2	1	w	w	ATTRACTIVE WARE/ lge round, growth cracks	no, dk fry
03-19-17	M	WA							w		yes
03-19-18	ME	WA							w		yes
03-19-19	ME	WA							w	sl EB	yes
03-19-20	M	WA	1.080	6	1	1	2	w+	w	gd skin	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Nadine x Shine											
03-20-1	ME	WA	1.081	6	1	1	1	g'met	w	sl EB/ small	yes
03-20-2	M	WA							w		yes
03-20-4	ME	WA	1.068	9	1	1	1	w	w	lrg no's, sl elongate	no, dk fry
03-20-6	ME	WA	1.060	10	1	1	1	w+	w	gd shape	no, dk fry
Purple Congo x Ruby Lou											
03-22-4	M		1.090	10	purple	1	1	g'met		red, red flesh	no, dk fry
03-22-7	M	WA							w		yes
Red Rascal x Ruby Lou											
03-28-2	M		1.075	7	1	2	2	g'met	w		yes
Riverina Russet x 96-141-12											
03-30-12	M	WA	1.091	3	1	4	3	Ff+	w	white smooth, high no. very even ob-long	no, ACD
03-30-16	ME	WA							w		yes
Riverina Russet x Innovator											
03-32-1	ML	WA	1.089	4	4	2	3	Ff?	w	cy, v sl, high yld, ob pear, shape size variable	no, slough
03-32-5	ME	WA	1.081	5	3	2	1	Ff	w	cw, sl ob thick, sl wide when lrg but even, poss too short	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Riverina Russet x Shepody											
03-33-7	ME	WA							w	round ware	yes
03-33-11	ME	WA							w	netted skin ware	yes
03-33-12	L		1.096	6	3	4	3	wedge		Fleck/ thk, ob. Russet, lrg to med sample, big yld	no, ACD
Spey x 96-141-12											
03-35-4	M	WA	1.088	6	1	2	3	Ff	w+	v g shape, sl netted ware/ obl - eliptic, sl flat ev shape & size	yes
Umatilla x 92-37-1											
03-39-1	M	WA							w	sl netted ware	yes
03-39-5	ME	WA	1.087	5	1	1	3	Ff?	w	sl netted oblong ware/ this is ?	no, slough
03-39-13	M	WA	1.088	8	1	2	3	Ff+	w	smooth ob ware/ ob to long, v attractive, lg to med, excellent	no, dk fry
Umatilla x 96-141-12											
03-41-04	ME	WA							c, w	sl netted ware & crisp	yes
80-174-8 x NZ 7013											
03-43-02	M										yes
85-30-12 x 80-102-7											
03-44-4	M	WA							w	flat oblong smooth skinned ware	yes
03-44-9	M	WA							w	oblong ware	yes
03-44-10	M	WA							w	good skin, oblong ware	yes
03-46-14	M	WA	1.077	4	1	2	2	c, w?	w	rd ware, good shape/	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Eureka x 89-30-8											
03-47-1	ML	WA							w	sl netted skin, ware	yes
03-47-7	M	WA	1.089	7	3	2	3	Ff?	w	ware, good shape, skin ok/ ob to long, sl wide need sl spacing most med	no, slough
90-77-4 (smooth skin, hi sg, dk fry) x Ruby Lou											
03-49-1	M	WA							w	v good colour, some distortions	yes
03-49-4	ML	WA	1.084	6	1	1	1	w	w	red, smooth, no scurf, ware/ red, light plum, red eye,sl double skin, sort ob, mod eye m some lge	yes
03-49-8	M	WA							w	ob, sl netted red skin, ware, knobs	yes
03-49-13	ML	WA								pale round red, space out	yes
03-49-14	M	WA	1.096	5	2	3	2	w+	w+	oblong red, sl netted skin/ keep, very uniform thi ob, med size shape even, big yld skin crimson, red eye, text skin, deep eyes heel fair colour	no, ACD
03-49-15	M	WA							w	pale round red ware, good shape	yes
03-49-21	L	WA							w+	oblong red, good colour	yes
91-158-6 9 (PCN resistance) x Nooksack											
03-50-3	M	WA							w	lilac eyes, oblong ware	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	Boiling tests‡ ACD	Boiling tests‡ Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Lustre x 93-37-3											
03-51-1	ME	WA	1.082	7	1	1	1	w	w	round flat, space out ware	yes
03-51-2	M	WA							w	oblong ware	yes
03-51-3	ML	WA	1.068	6	1	2	3	w+	w	round flat deep crown, ware	no, slough
03-51-4	M	WA							w	round flat ware	yes
03-51-5	ME	WA	1.063	7	3	2	1	w	w	oblong ware/ cw sm, thick ob m to lge	yes
03-51-6	ME	WA							w	oblong ware, space out	yes
03-51-8	M	WA							w?	blemish	yes
03-51-10	M	WA							w	blemish	yes
03-51-12	ME	WA	1.066	7	2	1	1	c/w+	w	space out/ w sm, r sl l, high no, small possible crisper	yes
03-51-14	ME	WA	1.059	8	1	1	1	w	w	round white ware, blemish	no, low SG
03-51-15	M	WA	1.070	8	1	1	2	w+	w	round white ware/ bw, sm, r to oval thick high no, smalls	no, dk fry
03-51-22	ME	WA	1.069	5	1	2	2	w+	w	round white ware, space out	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard variety											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Lustre x 96-32-19											
03-52-1	ML	WA	1.082	8	1	2	2	w+	w	obong ware, smooth white/ bw sm ob thick med high yield	no, dk fry
03-52-2	M	WA	1.078	8	1	2	2	w?	w	variable size, blemish free/ c, sm oval to pear, high no	no, dk fry
03-52-3	L	WA							w	good yield, deep crown	yes
03-52-4	VL	WA	1.080	6	1	1	1	w+	w	v good yield/ w sm thick r to ob, big yld shallow eyes heel	yes
03-52-5	M	WA	1.081	4	1	1	3	w	w	space out/ w sm r to oval, a little flat, odd blush, small space	no, slough
03-52-6	L	WA	1.081	6	1	2	3	w?	w?	ware, deep heel	no, slough
03-52-8	ML	WA							w	round blemish free ware	yes
03-52-14	M	WA	1.077	9	1	2	1	w?	w	good yield ware/ cw, sm to sl oval to sl pear	no, dk fry
03-52-15	ML	WA	1.076	7	2	2	1	w	w	blemish free, space out ware/ w sl flat ob, pear,sh eye heel,	yes
03-52-16	ME	WA							w	space out	yes
Lustre x Coliban											
03-54-1	ML	WA							w	good skin, round, even shape, ware	yes
03-54-2	L	WA							w	slightly misshapen, short oblong ware	yes
03-54-3	M	WA							w	round white ware, less blemish than next	yes
03-54-4	M	WA							w	round white ware, blemish	yes
Lustre x Crystal											
03-55-1	M	WA	1.086	8	2	1	2	w+	w	flat oblong/ bw sm, ob sl flat, fairly ev med	no, dk fry
03-55-2	M	WA	1.071	7	1	1	2	w+	w	v good skin, no blemish, ware	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
Lustre x Exton											
03-56-2	ML	WA							w	oblong ware	yes
03-56-3	M	WA	1.085	7	3	2	1	w	w	round smooth ware/ w sm, short ob, no lenti, more ob w lger, yld size smallish	yes
03-56-5	ML	WA	1.075	7	2	1	2	w	w	smooth white, poor shape, ware/ w sm , v few lenti, mod eye some dist w lge, se like, bit flat, HH & inner skin- cooking lab results	yes
03-56-7	ME	WA	1.072	8	1	2	1	w	w	good shape, blemish free/ w sm, ob sl long	no, dk fry
92-19-4 (Lustre sibling) x 93-37-3											
03-57-1	ML	WA	1.074	6	2	2	2	w+	w	flat, high yield/ keep, bw sm, oval to r sl long, v attractive	yes
03-57-2	ME	WA							w	good shape	yes
03-57-3	ME		1.075	6	3	1	2	w		sl EB/ sl eb, bw sm, r to short ob, deepish heel	yes
03-57-4	M	WA	1.080	6	2	3	2	w	w	oblong ware, lenticels/ cw sm, thick ob, some lenti	no, ACD
03-57-5	ME	WA	1.072	6	1	2	1	w+	w	ware/ sl eb, cw, thick short ob, few lenti, gd no	yes
03-57-7	ME	WA	1.066	9	1	2	1	w	w	ware/ w sm, lenti free, small run	no, dk fry

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	Boiling tests‡ ACD	Boiling tests‡ Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
92-19-4 (Lustre sibling) x Shine											
03-59-1	M	WA							w	ware, space out	yes
03-59-7	ME	WA	1.077	8	1	1	3	w+	w	white ware, good shape	no, slough
03-59-8	ME	WA	1.077	6	1	1	3	w+	w	round, good shape	no, slough
92-17-3 x 97-100-1 (F fry)											
03-60-10	ML	WA							w	slightly netted F fry & ware	yes
03-60-13	ML	WA	1.106	6	2	5	3	Ff+	w?	very good shape, skin too rough?/ long eliptic, good even run, med to lge, bad acd	no, ACD
03-60-17	M	WA							w	possible ware, space out	yes
03-60-18	ML	WA	1.093	5	1	3	3	Ff	w	possible ware, space out, chaining/ w sm to sl m, even size, shape, sl chaining (heat shoots), gd thk shape	no, ACD
03-60-19	M	WA									
Barman x 96-141-12 (high SG)											
03-63-9	M	WA							w	multipurpose ware?	yes
93-37-3 x Crystal											
03-65-1	M		1.080	7	2	3	3			HH, sprouting sl EB/ gd skin & shape, hh sprouting	no, ACD

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
94-117-2 x Barman											
03-66-1	M	WA							w	round flat ware, no blemish	
03-66-2	M		1.090	4	1	3	3	Ff+		gd yld, gd shape, gd skin, lrg ff, t.slater	no, ACD
03-66-3	M	WA							w	no ACD?, little blemish, v good skin, close up, ware	yes
03-66-8	ML										yes
94-117-2 x 95-109-6 (no ACD this cross?)											
03-67-5	ML	WA							w	no blemish, no ACD, close up, ware	yes
03-67-6	M	WA	1.103	5	2	3	2	Ff	w	ware/ gd shape, sl small, lrg dist, t.slater	no, ACD
03-67-7	ML	WA	1.093	6	2	2	3	Ff+	w	very good shape, netted skin, ware/ thick, sl dist, no blemish, t.slater	no, slough
03-67-16	M	WA							w	sl EB	yes
03-67-18	ML	WA	1.094	5	2	1	3	wedge	w	netted skin, no ACD, ware/ variable shape, c, sl text, all sorts, sprouting	no, slough
03-67-22	ML	WA							w	netted skin, ware	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
94-119-14 x MacRusset											
03-68-1	ME	WA	1.099	6	2	2	2	Ff	w	netted ware/ lb, sl rus, all oblong, all s-med, sl eb	yes
03-68-7	ME	WA							w?	ware	yes
95-109-6 (no ACD?) x Barman											
03-69-1	ME	WA	1.084	6	2	1	2	Ff	w	fair skin, ware/ SE, ob sl eliptic, cw, sl text, small-med, sprouting, small	yes
03-69-3	ME	WA							w	better skin than above, ware	yes
03-69-4	M									no ACD?	yes
03-69-5	ME									no ACD?	yes
03-69-11	L	WA							w	good skin, ware	yes
03-69-17	ML	WA							w+	slightly netted but good skin, ware	yes
03-69-18	M									no ACD?	yes
03-69-21	L	WA	1.089	8	3	1	3	Ff	w	lenticels, good skin, ware/ cw sm, thk ob to long, few tubers	no, dk fry
03-69-23	ML	WA							w	ware	yes
95-109-6 x 94-117-2 (No ACD this cross)											
03-70-1	M	WA							w	ware	yes
03-70-10	M	WA							w	better skin, flat oblong, ware	yes
03-70-25	ML	WA	1.107	7	3	1	2	Ff	w	better skin, shallower eyes, ware	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
95-109-6 x 96-141-12 (No ACD one parent)											
03-71-1	M	WA	1.071	4	1	2	2	w+/c+	w	good skin, ware/ w sm, r to oval sl flat, high no., most s to med	yes
03-71-13	ML	WA							w	fair skin, ware	yes
95-109-6 (No ACD this parent) x Stampede											
03-72-7	M	WA	1.088	5	2	1	3	Ff	w	slightly netted skin, no blemish, ware/ cw, ob to long, ls wide, gd yld, poss too wide	no, slough
95-97-9 (red ware) x 96-32-19											
03-78-1	L	WA	1.087	2	2	2	3	w+	w++	smooth white round, ware/ w sm, ob - r, thickish sh eyes	no, slough
03-78-2	ME	WA	1.071	8	2	1	2	w	w?	misshapen, ware/ c sm, oval to bit variable, m-lrg	no, dk fry
95-97-9 x Crystal											
03-79-1	ML	WA							w	ware	yes
03-79-2	E	WA							w	round, ware	yes
03-79-3	ML	WA	1.082	8	1	2	2	w	w	round, ware/ cw, v sl r, fairly thk, mod eye heel	no, dk fry
03-79-4	ME	WA	1.074	8	2	2	2	w	w	round, ware/ cw, vls r to oval, fairly thk	no, dk fry
03-79-7	ML	WA	1.087	5	2	2	2	w+	w	good skin, no blemish, round/ w sm, r, firmly thk, m-lrg	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Coliban 2	L		1.080	6	1	1.5	2				
Delaware 2	M		1.075	7.5	2	1.5	1				
Desiree 2	ML		1.089	6.5	4	2	2				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
96-32-19 x Shine (low ACD?) ware cross											
03-80-1	M	WA	1.081	8	1	1	3	w	w	very good skin & shape/ r to sl oval, flattish, bw, smooth, mod heel depth, small-m	no, dk fry
03-80-2	ME	WA	1.068	9	1	1	1	w	w	ware/ r fairly thk, bw sm, mod heel, small to med, 1 rot	no, dk fry
03-80-3	ME	WA							w	ware	yes
03-80-4	ML	WA							w?	slightly bold round shape	yes
03-80-5	M	WA	1.082	6	1	1	2	w	w	ware/ bw sm, r to oval, bit flat, deepish heel, m to small	yes
03-80-6	ML	WA							w	ware	yes
03-80-7	ME	WA	1.070	8	1	1	2	w?	w	ware, space out/ bw, sm, r to oval, flattish, mod eye heel, small high no.	no, dk fry
03-80-8	ML	WA	1.081	6	1	2	2	w?	w	good shape, ware/ bw, sm, r to oval, sl dist, odd GC, bit variable	yes
03-80-9	ME	WA							w	ware	yes
03-80-10	L	WA							w	ware	yes
03-80-11	E	WA	1.072	7	1	1	2	w?	w	slightly netted, round, space out/ r to val, w, sm, mod-sh eye heel	yes
03-80-12	ME	WA	1.071	8	2	2	2	w	w	ware/ w, sm, r to sl oval, fairly thk, mod eye heel, s-med	no, dk fry
03-80-13	ML										yes
03-80-14	ME	WA	1.082	4	1	1	3	w	w	blemish tolerant, ware	no, slough

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2b continued. Ware selections for WA from G2 selection plots harvested at VDPI-PBP in April 2005. Primary selection based on crosses (parents shown) and tuber characteristics. Final selection based on cooking quality.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →			≥1.060	<8		<3	<3				
Standard varieties											
Delaware 2	M		1.075	7.5	2	1.5	1				
Ruby Lou 2	M		1.082	5.5	2	1.5	1				
96-32-19 x Shine (low ACD?) ware cross continued											
03-80-15	ME	WA							w	round, ware	yes
03-80-16	ML	WA	1.077	7	1	1	2	w?	w	lots of blemish, round, ware, space out/ w sm, r to oval	yes
03-80-17	M	WA	1.076	8	2	2	3	w	w+	round flat, very bright skin, purple blush	no, dk fry
03-80-18	M	WA	1.093	5	2	1	3	w	w?	very deep heel,ware/ w sm, r thk, dp heel, od eye, even m-s	no, slough
03-80-19	ML	WA	1.069	10	2	1	2	w?	w	slightly netted, flat, ware	no, dk fry
03-80-20	ME	WA	1.071	9	1	1	2	w+	w	very good shape/ w, sm, r to oval, good shape, m-sh eye heel	no, dk fry
03-80-22	ME	WA	1.068	8	1	2	2	w+	w	very good shape/ w, sm r to oval, fairly thk sh eye heel	no, dk fry
03-80-23	ML	WA	1.075	8	1	1	2	w?	w	ware/ w sm, r to oval, thk, dp heel, mod eye, bit bold w lge	no, dk fry
03-80-24	M	WA	1.074	9	2	1	2	w?	w	ware	no, dk fry
03-80-25	ME	WA							w	ware	yes
03-80-26	M		1.081	4	1	1	2	w		cw, sm-sl, eliptic to ob, m even shape, sl pu crown blush	yes
97-100-1 (F fry) x Barman											
03-81-10	ME	WA							w?	possible ware despite netted skin	yes
97-100-1 x 95-110-8											
03-84-2	ML	WA	1.084	8	2	3	3	Ff+	f+	very good F fry shape, F fry	no, dk fry
97-100-1 (F fry) x 96-141-12											
03-85-6	M	WA	1.092	5	2	4	3	Ff?/w+	w	slightly netted, good shape for ware/	no, ACD
03-85-15	ME	WA	1.091	5	2	4	3	Ff?	w	reasonable skin for ware, oblong	no, ACD
03-85-19	M	WA							w	slightly netted skin, no blemish	yes

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

Table 5.1.2.2c. Selections other than crisp and ware from other than G2 generation in the G2 selection plots at VDPI-PBP.

Breeding line	Mat-* urity	Selected by	Spec. gravity	Fry† colour	Boiling tests‡ Col	ACD	Slough	Vic use~	WA use~	Comments	WA final selection
Selection criteria: →											
Standard variety											
Russet Bur 1	ML	WA	1.093	6	1	1	2	Ff+			
Russet Bur 3	ML		1.098	6	1	2	2				
88-102-24 x Ranger Russet											
02-74-25			1.101	3	2	1	3		f		yes
89-12-1 x Knox (ware)											
02-77-1			1.092	5	2	1	3		f w		yes f
89-12-1 x 89-30-8											
02-80-6			1.092	5	2	1	3		f w		yes f
Ranger Russet x Spey											
03-27-7	ME	WA							f		yes
03-27-11	ME		1.085	2	1	1	2	wedge		sl EB/ v ev ob to long LB, sl, few tubers	yes
80-174-8 x NZ 7013											
03-43-02	M										yes
Yanchip x Ranger Russet											
03-46-2	L	WA							f+	V netted F fry but very good shape	yes
Barman x Stampede											
03-64-8	L									2 late crinkled leaf R	yes
03-64-9	ML	WA							f+	very good F fry worth testing in WA	yes
93-37-3 x Crystal											
03-65-1	M		1.080	7	2	3	3			hh, sprouting, sl EB/ gd skin & shape, hh sprouting, sl eb	yes
94-119-14 x MacRusset											
03-68-5	L	WA	1.109	5	3	1	3	Ff	f	possible f fry/b rus, lrg to m, few tubers, lg fairly thk	yes
97-100-1 x 95-110-8											
03-84-2	ML	WA	1.084	8	2	3	3	Ff+	f+	very good F fry shape, F fry/long thk cyl, attract, even shape	no, SG & fry

* Maturity, E = early, M = mid, L = late, V = very

† Fry colour: visually assessed on scale 1 - 10 (light to dark), <7 acceptable for crisp processing.

‡ Boiling tests: col = flesh colour

@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening

~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.

~use: c = crisp, Ff = French fry, w = ware (fresh), g'met = gourmet, ? = questionable, + = very good

5.2 Virus testing of breeding lines from VDPI-PBP

5.2.1 Background

It is a WA quarantine requirement that tubers of breeding lines from the VDPI-PBP be tested and found free of potato virus Y. Only PVY free tubers can be planted in WA.

5.2.2 Virus test results for breeding lines selected from VDPI-PBP in 2004

The breeding lines were tested by AGWEST Plant Laboratories (laboratory sample 05/1969). No virus was found, the analysis report read:

> "*Three hundred (300) potato tubers consisting of three (3) groups of one hundred (100) lines were tested for Potato virus X, Potato virus Y, Potato virus S, Potato leafroll virus and Tomato spotted wilt virus in thirty three (33) groups of nine (9).*
>
> *Results showed that Potato virus X, Potato virus Y, Potato virus S, Potato leafroll virus and Tomato spotted wilt virus were not detected in any of the samples tested.*
>
> *Only two (2) of the three (3) tubers in lines 39, 46, 64, 49, and 55 were able to be tested for the above viruses.*
>
> *Only one (1) of the three (3) tubers in lines 58 and 47 were able to be tested for the above viruses.*
>
> *None of the three (3) tubers in line 50 were able to be tested for any of the above viruses.*
>
> *Only two (2) of the three (3) tubers in lines 11, 29, 39, 58, 64 and 93 were able to be tested for Potato leafroll virus, but all three (3) tubers of each of these lines were able to be tested for Potato virus Y, Potato virus X, Potato virus Y, Potato virus S and Tomato spotted wilt virus, none of which were detected in the samples tested*."

The reason why testing was incomplete was due to the failure of some tubers to germinate. The lines that could not be tested for potato virus Y were not planted and were destroyed.

The virus tested breeding lines grew successfully in the field but multiple thin shoots were produced by many breeding lines and it is suspected that gibberellic acid contamination may have occurred and affected growth.

5.2.3 Virus test results for breeding lines selected from VDPI-PBP in 2005

Virus testing will also be done on breeding lines from VDPI-PBP selected in 2005 for WA. Additional precautions will be taken to ensure that gibberellic acid contamination cannot occur.

5.3. Seed bulking of 2004 VDPI-PBP selections

Breeding lines selected in 2004 were bulked over summer 2004/05 in WA to provide seed for a winter screening (see next section). This seed was bulked under the WA Certified seed scheme. A list of material is given in Table 5.3. Standard varieties were Atlantic, Coliban, Delaware, Desiree, Kennebec, Mondial, Nadine and Ruby Lou.

Many breeding lines produced multiple, spindly shoots. It is suspected that the problem was due to gibberellic acid contamination of the seed pieces that may have occurred as the tubers were cored for virus testing. . The shoots eventually thickened as the crop grew.

Table 5.3. Breeding lines selected at VDPI-PBP in April 2004 and tested free for potato virus Y in WA. These breeding lines were bulked in summer 2004/05 to provide seed for a winter screening planted in May 2005.

Plot	Entry	Plot	Entry	Plot	Entry
1	01-1-1	32	02-35-1	63	02-80-6
2	01-3-5	33	02-35-2	64	02-80-8
3	01-4-5	34	02-35-3	65	02-80-11
4	01-8-18	35	02-35-4	66	02-83-4
5	01-20-9	36	02-35-6	67	02-83-17
6	01-20-23	37	02-35-7	68	02-84-8
7	01-34-18	38	02-35-8	69	02-84-11
8	01-37-2	39	02-35-12	70	02-84-17
9	01-41-7	40	02-35-15	71	02-86-4
10	01-46-32	41	02-35-17	72	02-86-8
11	01-46-58	42	02-35-19	73	02-86-10
12	01-55-10	43	02-35-20	74	02-86-16
13	01-56-11	44	02-35-22	75	02-86-20
14	01-56-13	45	02-35-29	76	02-86-21
15	01-66-1	46	02-36-5	77	02-86-22
16	01-77-3	47	02-37-1	78	02-87-1
17	01-79-5	48	02-63-9	79	02-87-2
18	01-82-18	49	02-70-1	80	02-87-4
19	01-87-11	50	02-72-2	81	02-87-5
20	01-88-5	51	02-73-8	82	02-87-7
21	01-88-6	52	02-76-3	83	02-87-10
22	02-12-6	53	02-78-11	84	02-87-11
23	02-18-3	54	02-76-13	85	02-87-13
24	02-29-5	55	02-76-17	86	02-88-5
25	02-34-1	56	02-77-1	87	02-88-6
26	02-34-2	57	02-77-11	88	02-88-11
27	02-34-4	58	02-77-15	89	02-88-13
28	02-34-8	59	02-78-1	90	02-89-1
29	02-34-11	60	02-80-1	91	02-89-2
30	02-34-12	61	02-80-4	92	02-90-1
31	02-34-14	62	02-80-5		

5.4. Winter screening of 2004 VDPI-PBP selections

Selections shown in the previous seed bulking were planted in an unreplicated winter screening in May 2005. Results of this screening will be reported in the final report of project PT05017 *Variety development for the fresh potato market in WA 2005/06*.

5.5. District trial for fresh market winter production 2004

Crisp, fresh market and French fry selections from the "00" and "99" series of breeding lines (Dawson & Mortimore 2004b) were tested in fresh market district trial at Mandogalup (Perth) in 2004. Those which were characterised as fresh market types at harvest, according to tuber characteristics, are shown in Table 5.5.

Emergence rates were poor for six entries: Coliban (52%), Nadine (68%), 98-109-1 (53%), 99-61-13 (49%), 00-1-5 (50%) and 00-11-28 (42%). Other entries had high emergence rates averaging 89%. The trial grew well despite frosts. Yield and quality data are shown in Table 5.5.

Selections had suitable tuber characteristics, yield greater than 26.3 t/ha (not significantly lower (P<0.05) than Delaware), specific gravity greater than or equal to 1.060 (significantly greater than Nadine's 1.053), with after-cooking-darkening and sloughing less than 2.5 and 2.8 respectively. Fry colour had to be acceptable at 7 or less. Entries had to be free of major faults. Selections were Ruby Lou, Victoria, White Star (97-38-2), 99-23-11 and 00-58-1. An exception was made for Maris Piper which had a dark French-fry colour of 7.3 because its high tolerance to powdery scab (Dawson & Mortimore 2003b) was thought to make-up for the darker than desired fry colour. 98-109-1 was also selected, despite its low yield, as it had poor emergence of just 53%.

These selections are conditional on favourable reaction to powdery scab. This reaction was tested in Section 5.7. The selections Victoria, 99-23-11 and 00-58-1 were shown to be tolerant of powdery scab. The results for the other entries are preliminary and consistent results from another year's trial are required for confirmation.

Table 5.5. Yield and quality of fresh market entries in a May 2004 planted district trial at Mandogalup.

Planted: 4 May 2004 Row spacing: 70 cm				Harvested: 13 October 2004 Soil temp. at harvest: 19°C						Soil type: alkaline sand Elevation: 20 m			
Entry, tuber* characteristics & spacing in rows (cm)		Yield (t/ha)						Rank by Grade No.1	Tuber no. per plant	Quality			
		Chats 0-70g	Small 70-120g	Medium 120-350g	Large 350-450g	Grade No. 1 70-450g	Oversize >450g			SG	ACD @	Sloughing~	Fry# color
Selection criteria													
Suitable						>26.3				>1.060	<2.5	<2.8	<7.7
Cherry Red	24	4.2	6.0	37.2	4.4	47.6	2.1	4	6.6	1.062	1.8	1.3	8.0
Coliban	15	1.8	4.1	20.1	2.0	26.3	0.4	20	4.1	1.072	1.0	1.3	7.7
Delaware	24	3.7	8.3	35.5	1.2	45.1	0.3	8	6.5	1.068	1.5	1.8	7.0
Maris Piper	30	2.8	7.7	35.3	2.1	45.1	0.4	7	8.9	1.072	1.3	2.3	7.3
Mondial	15	2.5	6.9	41.8	10.2	58.8	6.1	1	5.4	1.063	1.2	1.3	7.7
Nadine	24	1.6	4.0	21.8	5.2	31.0	2.6	18	6.1	1.053	1.0	1.2	9.0
Ruby Lou	20	2.6	6.8	42.4	7.8	56.9	3.5	2	6.1	1.074	1.3	1.7	6.7
Victoria	30	2.8	5.9	34.2	2.4	42.4	0.0	12	7.7	1.068	1.0	1.0	7.0
White Star (97-38-2)	30	1.3	3.6	35.4	6.0	45.0	1.4	9	6.5	1.072	1.5	1.5	5.7
97-101-7	24	2.4	7.2	32.2	0.2	39.6	0.0	14	5.6	1.072	1.0	1.2	6.3
98-31-3	24	2.4	6.4	30.1	0.4	37.0	0.6	16	5.8	1.070	1.3	1.8	7.0
98-109-1	30	1.3	4.8	18.2	2.6	25.6	0.4	21	7.8	1.077	2.0	1.2	4.7
99-23-11	24	2.2	6.0	42.0	5.5	53.5	1.6	3	6.7	1.082	1.5	1.7	4.7
99-61-13	24	2.0	3.4	15.1	1.5	20.0	0.3	23	6.2	1.074	1.5	1.7	7.0
00-1-5	24	1.6	3.0	16.6	2.0	21.5	1.6	22	5.1	1.069	1.3	3.3	6.0
00-6-24	24	2.6	5.0	28.4	4.9	38.3	5.6	15	7.3	1.069	1.5	1.8	8.0
00-11-28	30	1.1	2.7	10.1	0.0	12.8	0.0	24	6.3	1.079	2.5	3.2	7.0
00-15-30c	36	5.3	8.1	25.8	0.0	33.8	0.0	17	10.8	1.080	1.8	3.3	4.7
00-15-67	24	10.3	16.0	30.0	0.0	46.0	0.0	5	11.5	1.081	1.2	3.7	7.0
00-16-17	24	6.7	12.4	30.8	0.5	43.8	0.0	10	9.8	1.085	1.2	4.0	5.3
00-26-1	20	2.8	5.3	33.9	0.8	40.1	0.6	13	5.0	1.069	1.3	2.8	7.3
00-48-1	20	3.4	6.8	32.3	4.2	43.3	1.2	11	6.2	1.063	1.2	1.5	7.3
00-58-1	24	5.0	9.5	35.4	0.8	45.6	0.0	6	7.4	1.075	1.3	1.7	6.7
00-69-8	30	2.3	5.7	21.5	0.0	27.3	0.0	19	6.6	1.059	1.2	1.7	8.0
Significance+		***	***	***	***	***	***		***	***	***	***	***
LSD P = 0.05		3.2	6.5	17.1	7.0	18.8	5.7		2.3	0.007	1.1	1.5	1.7

* Tuber characteristics: **bold** typeface = suitable, plain type = questionable, *italic* = unsuitable.
@ ACD (after-cooking-darkening): 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5=general blackening
~ Sloughing: 1 = nil, 2 = slight, 3 = moderate, 4 = severe, 5 = soupy.
# Samples assessed visually after crisping: 1 - 10, 7 = borderline, >7 = too dark for domestic French-fries.
+ "skew" indicates data did not fulfil assumptions of analysis of variance.

5.6. District trial for crisp winter production 2004

Crisp, fresh market and French fry selections from the "00" and "99" series of breeding lines (Dawson & Mortimore 2004b) were tested in fresh market district trial at Mandogalup (Perth) in 2004 as described in Section 5.5. The average yield of commercial ware varieties (Delaware, Mondial, Nadine and Ruby Lou) in this trial was high for winter at 48 t/ha. Emergence rate was poor for Atlantic at just 37%. Other entries had emergence of 86% or greater. The trial grew well despite frosts. Yield and quality data are shown in Table 5.6. Yield of Atlantic was low at just 34 t/ha: average yield for the trial was 33 t/ha. Last year Atlantic yielded 41 t/ha and trial average was 36 t/ha.

Entries which were characterised as crisps at harvest, according to tuber characteristics, are shown in Table 5.6. We aimed to select entries with high yield, specific gravity and light fry colour when grown under cold conditions with tolerance to powdery scab. Frosty periods meant sprinklers were used for frost control and powdery scab was worse than usual. Powdery scab index was from a nearby disease screening trial or from previous years' tests.

To be selected entries had to have suitable tuber characteristics, specific gravity not highly significantly less than Atlantic (i.e > 1.081) and fry colour not significantly darker than Atlantic. Selection criteria are shown at the head of columns in Table 5.6. Selections had to have suitable tuber characteristics and yield could not be significantly lower than Atlantic. No major faults were allowed. 00-16-17 had 23% hollow tubers. Selections were Atlantic and 99-23-11. 99-23-11 was also selected in the fresh market trial (Section 5.5).

Table 5.6. Yield and quality of crisp entries in a May 2004 planted district trial at Mandogalup.

Planted: 4 May 2004		Harvested: 13 October 2004							Soil type: alkaline sand					
Row spacing: 70 cm		Soil temp. at harvest: 19°C							Elevation: 20 m					
Entry tuber* characteristics & spacing in rows (cm)		Yield (t/ha)						Rank by Grade No.1	Tuber no. per plant	Quality				
		Chats 0-70g	Small 70-120g	Med-ium 120-350g	Large 350-450g	Grade No. 1 70-450g	Over size >450g			SG	Fry# color	Flesh faults †	Pwd scab‡	ACD @
Selection criteria														
Suitable						>26.4				≥1.082				
Atlantic	15	2.5	7.3	24.3	1.9	33.6	0.7	3	8.3	1.089	5.7	0	tol	1.8
99-23-11	24	2.2	6.0	42.0	5.5	53.5	1.6	1	6.7	1.082	4.7	3	tol	1.5
00-15-18	24	10.7	14.5	14.3	0.0	28.8	0.0	4	9.2	1.085	4.3	0	sus	1.2
00-15-25	30	10.0	8.9	3.7	0.0	12.6	0.0	6	8.2	1.078	4.3	0	tol	1.2
00-15-40	24	14.4	17.8	10.1	0.0	27.8	0.0	5	11.1	1.091	4.7	0	tol	1.3
00-16-17	24	6.7	12.4	30.8	0.5	43.8	0.0	2	10.6	1.085	5.3	27†	tol	1.2
Significance		***	**	***	ns	***	ns		*	***	ns			ns
L.s.d. (P<0.05)		7.6	11.7	15.9		17.2			4.9	0.007				

* Tuber characteristics: **bold** typeface = suitable, plain type = questionable, *italic* = unsuitable.
# Samples assessed visually after crisping: 1 - 10, 6 = borderline, >6 = too dark for crisps.
† indicates significantly different flesh disorders from Atlantic.
‡ Powdery scab reaction: tol = tolerant, sus = susceptible h = highly, data from disease screening. Needs confirmation in another test. Atlantic result from Dawson & Mortimore (2004a).

5.7. Disease screenings 2004

Entries for the district trials were also planted in a disease screening to test for field tolerance to powdery scab and the disorder "crocodile skin" cause unknown.

Powdery scab

Powdery scab results are shown in Table 5.7a. The entries selected in the fresh and crisp variety trials (Sections 5.5 & 5.6) were shown to be tolerant of powdery scab. These were Victoria, 99-23-11 and 00-58-1. These preliminary results must be confirmed with another year's experimental data.

Table 5.7a. Field tolerance to powdery scab of potato entries in a trial at Baldivis.

Entry	Trial				Susceptibility over two screenings
	02AL40 (Dawson & Mortimore 2004a)		Mandogalup 2004		
	Arsin severity* score	Susceptibility rating~	Severity* score	Susceptibility rating~	
Cherry Red			2.02	highly sus	
Desiree	1.87	tolerant control	0.54	tolerant	tolerant
PO3	3.46	highly susc.	1.56	suscept	suscept
Victoria			0.78	tolerant	
Nadine	2.26	tolerant	0.87	tolerant	tolerant
97-101-7			1.41	suscept	
98-4-5	4.16	highly susc.	1.66	suscept	suscept
98-10-11	3.68	highly susc.	1.64	suscept	suscept
98-31-3			1.57	suscept	
98-34-11	0.77	tolerant	0.59	tolerant	tolerant
98-109-1	0.31	tolerant	0.48	tolerant	tolerant
99-23-11			0.85	tolerant	
99-61-13			1.08	tolerant	
00-1-5			1.27	tolerant	
00-6-24			1.23	tolerant	
00-11-28			0.52	tolerant	
00-15-18			1.53	suscept	
00-15-25			0.46	tolerant	
00-15-30			0.99	tolerant	
00-15-40			0.85	tolerant	
00-15-67			1.19	tolerant	
00-16-17			1.10	tolerant	
00-26-1			0.73	tolerant	
00-48-1			0.85	tolerant	
00-58-1			1.17	tolerant	
00-69-8			1.35	tolerant	
Significance+	***		***		
LSD P = 0.05	1.32		0.86		
LSD P = 0.01	1.74		1.14		

* Severity = number of tubers with 0-5% surface covered with disorder + (tubers with 5-25% disorder x 2) + (tubers with >25% disorder x 3) divided by total number of tubers.

~ Rating = tolerant if severity score is not sig. diff (5%) to the tolerant control,
Rating = susceptible if the severity score is sig. greater (1%<P<5%) than the tolerant control,
Rating = highly susceptible if the severity score is highly significantly (P<1%) greater than the control.

Crocodile skin

Crocodile skin results for two screening trials are shown in Table 5.7b. Tolerant entries selected in the variety trials (Sections 5.5 & 5.6) were 99-23-11 and 00-58-1.

Table 5.7b. Field tolerance to crocodile skin of potato entries in a trial at Baldivis.

Entry	Trial				Susceptibility over two screenings
	02AL40 (Dawson & Mortimore 2004a)		Mandogalup 2004		
	Severity* score	Susceptibility rating~	Severity* score	Susceptibility rating~	
Cherry Red			0.00	tolerant	
Desiree	0.44	tolerant	0.55	suscept	inconsistent
PO3	0.08	tolerant	0.05	tolerant	tolerant
Victoria			0.24	suscept	
Nadine	0.08	tolerant control	0.07	tolerant	tolerant
97-101-7			0.07	tolerant	
98-4-5	0.31	susceptible	0.04	tolerant	inconsistent
98-10-11	0.02	tolerant	0.00	tolerant	tolerant
98-31-3			0.00	tolerant	
98-34-11	0.00	tolerant	0.00	tolerant	tolerant
98-109-1	0.07	tolerant	0.18	tolerant	tolerant
99-23-11			0.11	tolerant	
99-61-13			0.00	tolerant	
00-1-5			0.11	tolerant	
00-6-24			0.04	tolerant	
00-11-28			0.00	tolerant	
00-15-18			0.12	tolerant	
00-15-25			0.58	suscept	
00-15-30			0.39	suscept	
00-15-40			0.32	suscept	
00-15-67			0.30	suscept	
00-16-17			0.13	tolerant	
00-26-1			0.02	tolerant	
00-48-1			0.04	tolerant	
00-58-1			0.02	tolerant	
00-69-8			0.00	tolerant	
Significance+	***		***		
L.s.d. (*P* <0.05)	0.18		0.31		
L.s.d. (*P* <0.05)	0.23		0.41		

* Severity = number of tubers with 0-5% surface covered with disorder + (tubers with 5-25% disorder x 2) + (tubers with >25% disorder x 3) divided by total number of tubers.

~ Rating = tolerant if severity score is not sig. diff (5%) to the tolerant control,
Rating = susceptible if the severity score is sig. greater (1%<P<5%) than the tolerant control,
Rating = highly susceptible if the severity score is highly significantly (P<1%) greater than the control.

5.8. Demonstration for winter fresh market production 2005

Selections from the 2004 fresh market district trial (Section 5.5) were planted in May 2005 in a demonstration at Baldivis. Entries are shown in Table 5.8. One of these entries, 99-23-11, was also the sole selection from the 2004 crisp district trial (Section 5.6). This demonstration is due to be harvested in late October 2005.

Table 5.8. Selections for 2005 May planted fresh demonstration at Baldivis.

	Entry	Comments
1	Delaware	Standard variety
2	Maris Piper	Selection from district trial despite dark fry colour - Section 5.5
3	Mondial	Standard winter variety (pale yellow flesh)
4	Nadine	Standard variety
5	Ruby Lou	Standard red variety
6	Victoria	Selection from district fresh trial (yellow flesh)
7	White Star (97-38-2)	Advanced breeding line due for release in late 2005
8	00-58-1	Selection from district fresh trial - Section 5.5
9	96-141-12 (Windsor)	Advanced breeding line with winter F-fry potential
10	98-109-1	Selection from district fresh trial - Section 5.5
11	98-34-11	Red skinned breeding line with very good tolerance to powdery scab (see Table 5.7a)
12	99-23-11	Selection from district fresh & crisp trials – Sections 5.5/6

5.9. Winter & autumn crisp demonstrations for the Swan Coastal Plain

June planting

The crisp demonstration comprised the following breeding-lines: 94-28-1, 97-74-3, 97-84-6 and 98-10-11 which were selected by Dawson & Mortimore (2004a). This is the first of two plantings to test their suitability for double crop production on the Swan Coastal Plain. The standard variety was Atlantic. The demonstration grew poorly and did not close in the rows. Most entries died early and were badly affected by *Alternaria* blight. Selections had suitable tuber characteristics, specific gravity greater than 1.084, fry colour and flesh faults had to be acceptable (Table 5.9a). Selections were Atlantic, 94-28-1 and 98-10-11.

Table 5.9a. Yield and quality of crisp entries in a June 2004 planted demonstration at Lancelin.

Planted: 25 June 2004 Row spacing: 75 cm		Harvested: 24 October 2004 Soil temp. at harvest: 30°C							Soil type: grey sand Elevation: 100 m				
Entry tuber* characteristics & spacing in rows (cm)		Yield (t/ha)						Rank by	Tuber no.	Quality			
		Chats 0-50g	Small 50-80g	Med-ium 80-300g	Large 300-430g	Grade No. 1 50-430g	Over size >430g	Grade No.1	per plant	SG	Fry# color	Flesh faults †	Pwd scab‡
Selection criteria													
Suitable										≥1.084	<7		
Atlantic	20	1.7	5.0	40.8	0.0	45.8	0.0	3	7.6	1.089	4	6	tol
Atlantic (grwr's seed)	20	1.7	4.8	42.8	0.3	48.0	0.0	1	7.7	1.090	3	4	
94-28-1	25	3.3	7.0	27.0	0.0	34.0	0.0	5	10.0	1.097	1	0	tol
97-74-3	30	3.2	7.0	22.8	0.0	29.8	0.0	6	11.5	1.092	2	0	susc
97-84-6	30	2.2	4.9	37.4	0.0	42.2	0.0	4	10.4	1.084	6	0	susc
98-10-11	25	3.9	4.8	42.1	0.3	47.3	0.0	2	10.9	1.088	5	2	susc
Significance												ns	

* Tuber characteristics: **bold** typeface = suitable, plain type = questionable, *italic* = unsuitable.
# Samples assessed visually after crisping: 1 - 10, 6 = borderline, >6 = too dark for crisps.
† indicates significantly different flesh disorders from Atlantic.
‡ Powdery scab reaction: tol = tolerant, sus = susceptible h = highly, Data for 98-10-11 from disease screening, needs confirmation in another test. Data for other entries from Dawson & Mortimore (2004a).

March planting

This is the second of two plantings to test their suitability for double crop production on the Swan Coastal Plain. The standard variety was Atlantic. The demonstration grew well initially but then died early when affected by *Alternaria* blight. Selections had suitable tuber characteristics, specific gravity greater than 1.075, fry colour and flesh faults had to be acceptable (Table 5.9b). Selections were 94-28-1, 97-74-3 and 97-86-4. 98-10-11 had low specific gravity and was not selected.

Table 5.9b. Yield and quality of crisp entries in a March 2005 planted demonstration at Lancelin.

Planted: 7 March 2005 Row spacing: 75 cm		Harvested: 7 July 2005 Soil temp. at harvest: 4°C						Soil type: grey sand Elevation: 100 m					
Entry tuber* characteristics & spacing in rows (cm)	Yield of round seed (t/ha)						Cut seed yield (% of	Tuber no. per plant	Quality			
	Chats 0-50g	Small 50-80g	Med-ium 80-300g	Large 300-430g	Grade No. 1 50-430g	Over size >430g			SG	Fry# color	Flesh faults †	Pwd scab‡
Selection criteria												
Suitable									≥1.077	<7	<60	
Atlantic 20	3.4	3.7	30.7	0.0	34.4	0.0	86	7.2	1.080	5	70	tol
Atlantic (grwr's seed) 20	1.3	2.9	29.8	0.2	33.0	0.0	89	6.3	1.077	5	60	
94-28-1 25	4.3	5.3	16.2	0.0	21.4	0.0	92	10.5	1.086	5	0†	tol
97-74-3 30	5.6	7.5	19.1	0.0	26.6	0.0	83	15.4	1.077	6	0†	susc
97-84-6 30	2.9	5.6	20.2	0.0	25.8	0.0	103	10.3	1.078	5	0†	susc
98-10-11 25	6.8	10.9	18.3	0.0	29.2	0.0	70	13.7	1.072	3	2†	susc
Significance											*	

* Tuber characteristics: **bold** typeface = suitable, plain type = questionable, *italic* = unsuitable.
# Samples assessed visually after crisping: 1 - 10, 6 = borderline, >6 = too dark for crisps.
† indicates significantly different flesh disorders from Atlantic.
‡ Powdery scab reaction: tol = tolerant, sus = susceptible h = highly, Data for 98-10-11 from disease screening, needs confirmation in another test. Data for other entries from Dawson & Mortimore (2004a).

A processing company also assessed the quality of most entries (Table 5.9c). The specific gravity results were similar to those shown in Table 5.8b but the chip defect data helps to identify the better entries. All breeding lines assessed had less chip defects than Atlantic. 98-10-11 was shown to have poor colour but 97-74-3 was shown to have very low chip defects of just 4% compared with Atlantic's 41 - 48%.

Table 5.9c. Processor assessment of quality of crisp entries in a March 2005 planted demonstration at Lancelin.

Entry	Tubers per 10 kg	Specific gravity	Chip defect	
			%	Description
Atlantic	73	1.079	48	Dk brown colour/undesirable/bruising
Atlantic (grower's seed)		1.077	41	colour
94-28-1		1.086		
97-74-3	84	1.077	4	
97-84-6	83	1.076	12	Colour, bruise
98-10-11	99	1.071	17	Colour not good

5.10. White Star commercial testing 2005

Commercial Production Results 2005

Commercial testing of White Star progressed to its fourth year. Previous tests have shown this variety to be a suitable candidate for replacing Delaware and Nadine for winter production. It produces yields similar to the standard varieties but with improved pack-outs (Dawson & Mortimore 2004b). Details can be found in Dawson and Mortimore (2004b) and Mortimore *et al.* (2005).

Pack-out data for 2003 and 2004 for White Star is shown in Table 5.10. These data were presented by Dawson & Mortimore (2004b) however the completed pack-out data for Nadine is presented for the first time. These data show that over two years White Star had a higher percentage of Premium and Grade 1 tubers than Nadine. Premium and Grade 1 for White Star averaged 79% while Nadine's average was 56%.

Complete 2005 pack-out data are not yet available but individual pack-outs so far indicate similar results to previous years. White Star produced 74% Grade 1 (Premium grade no longer exists) while Nadine produced 63% Grade 1 (Table 5.10).

Table 5.10. Pack-outs for White Star and Nadine for 2002/03 and 2003/04. Data supplied by Western Potatoes.

Variety	Premium (%)	Grade 1 (%)	Grade 2 (%)	Smalls (%)	Waste (%)
Season 02/03 (2003)					
Nadine	8	44	21	16	8
White Star (97-38-2)*	7	75	9	3	3
Season 03/04 (2004)					
Nadine	17	43	17	14	6
White Star (97-38-2)*	17	59	8	10	4
Season 04/05 (2005)					
Nadine†		63	24	7	6
White Star (97-38-2)‡		74	16	6	5

* from Dawson & Mortimore (2004b)
† Average of 8 deliveries, each 20 tonnes from one farm.
‡ Average of 4 deliveries, each 20 tones from same farm as Nadine.

One farmer who is testing White Star for the first time in 2005 reported that he had harvested one plot of White Star and Delaware that had been badly affected by *Alternaria* blight. He reported that the wash-packer was very impressed with the White Star pack-out of 70% Grade 1 with 16% smalls. In comparison Delaware achieved 43% Grade 1 with 43% smalls. Delaware yielded 18 t/acre while White Star produced 16 t/acre. The lower yield of the White Star was more than compensated by the improved pack-outs and so the farmer will be ordering White Star seed for next year (George Ivankovich personal communication).

5.11. Auski & Billabong commercial testing 2004/05

500 kg of seed of both Auski (95-11-20) and Billabong (95-37-12) were supplied to two growers at Pemberton in early December 2004. These are advanced breeding lines identified by Dawson & Mortimore (2004a) as being worthy of commercial testing at Manjimup and Pemberton. The seed was planted as a strip in their commercial crops close to a planting of Delaware. At harvest the varieties were wash-packed, presented to growers at a field day and then sold through two supermarkets. Western Potatoes Ltd assessed the out-turn of the varieties in the retail stores.

At Mr Humphrey's site both Auski and Billabong were compared with Delaware. Both Auski and Billabong had at least 10% more Grade 1 than Delaware (Table 5.11). However there was a greater proportion of Small Grade in these two new varieties compared with Delaware. Delaware produced 30% waste at this site compared with 8 and 10% from Auski and Billabong respectively.

At Messers De Campo's site Auski and Billabong were compared with Nadine. Here both Auski and Billabong had similar Grade 1 to Nadine (Table 5.11). Grade 2 was greater in Auski and Billabong than Nadine but the difference was probably due to the high waste level of 13% in Nadine.

Packers were concerned about the shelf life of Billabong and skin set may be a problem. Auski appeared to have superior shelf life. The Frontispiece shows the superior appearance of Auski and Billabong compared with Delaware.

Table 5.11. Pack-out by variety for Auski and Billabong commercial tests 2004/05. Table shows percentage achieved of each grade.

Grade	Auski	Billabong	Delaware	Nadine
	Grower: Humphrey			
Premium	0	0	0	
Grade 1	58	55	45	
Grade 2	12	8	9	
Smalls	20	24	14	
Waste	8	11	30	
Soil	2	2	2	
Tonnes delivered	2.5	2	2.5	0
	Grower: De Campo			
Premium	0	0		0
Grade 1	40	44		42
Grade 2	44	34		29
Smalls	10	16		15
Waste	4	4		13
Soil	2	3		3
Tonnes delivered	5.5	4	0	21

5.12. Bliss (90-2-6): clean seed source

This crisp variety consistently produces higher specific gravity than Atlantic (Dawson & Mortimore 2004b, Dawson *et al.* 2005) and there is demand from industry for material to allow commercial testing. Testing and commercial evaluation was disrupted when this variety was found to be a symptomless carrier of potato virus Y. In order to make clean seed available virus free tubers from AGWEST Plant Laboratories were sent to DPIWE in Tasmania for pathogen testing. The material was successfully cleaned and minitubers were produced. These were successfully bulked in 2004/05 and leaves were tested for PVY to ensure that the pathogen testing procedure had been successful. This material will be released to industry in late 2005.

5.13. Seed bulking 2004/05

Breeding lines for demonstrations and advanced testing must be maintained in the WA Certified Seed Scheme to provide seed for future tests. The thirty breeding lines maintained in 2004/05 are shown in Table 5.13. These were inspected and passed under the WA Certified Seed Scheme.

Table 5.13. Advanced breeding lines and varieties bulked during 2004/05 to provide seed for further testing.

Entry		Comments
1	Atlantic	Standard
2	Bliss (90-2-6)	Advanced crisp line
3	Cherry Red	Red skin to be assessed by packer
4	Coliban	Standard fresh variety in the eastern states
6	Desiree	Standard Australian red skinned variety
7	Maris Piper	Advanced fresh line for winter production
11	Victoria	For fresh winter demonstration 2005
12	94-28-1	For crisp autumn demonstration 2005
13	95-11-20 (Auski)	Advanced fresh line for summer commercial tests
14	95-37-12 (Billabong)	Advanced fresh line for summer commercial tests
15	96-141-12 (Windsor)	For fresh winter demonstration 2005
16	97-38-2 (White Star)	Advanced fresh line for winter production
17	97-74-3 (Vectra)	For crisp autumn demonstration 2005
18	97-84-6	For crisp autumn demonstration 2005
19	97-102-1 (Monaro)	Potential for F- fry Manjimup/Pemberton
20	98-4-5	Potential for ware Manjimup/Pemberton
21	98-10-11	For crisp autumn demonstration 2005
22	98-27-03	Potential for crisp Manjimup/Pemberton
23	98-31-22	Potential for ware Manjimup/Pemberton
24	98-34-11	Powdery scab resistant red skinned fresh variety
25	98-107-13	Potential for ware Manjimup/Pemberton
26	98-109-1	F-fry/ware poor germ, for fresh winter demonstration 2005
27	99-23-11	For fresh winter demonstration 2005, also crisp potential
28	00-6-24	Potential for ware Manjimup/Pemberton
29	00-15-40	Potential for ware Manjimup/Pemberton
30	00-58-1	For fresh winter demonstration 2005

6. Discussion

6.1. Introduction

This report gives results for just one year's activities, which is a short time for achieving outcomes from variety evaluation work. Nevertheless we have been aided by our previous variety evaluation projects and can report on several achievements.

6.2. Quarantine

We have adopted a procedure whereby each tuber introduced from the VDPI-PBP breeding program can be tested for virus and also be retained for planting. AGWEST Plant Laboratories undertake this procedure. The procedure appears to be successful although there may have been contamination of tubers with gibberellic acid which could account for the multiple spindly shoots produced by many breeding lines. Most breeding lines grew out of this habit. Nevertheless we are taking additional precautions to ensure gibberellic acid contamination does not occur. The breeding lines that were affected underwent a seed bulking in preparation for a winter screening. The spindly shoot growth did not affect the program as no selection pressure was applied during the seed bulking. However as new industry priorities are tackled the first seed bulking may be used as a screening and so it is important the virus testing procedure is developed that does not affect growth.

6.3. Selections from VDPI-PBP

It is difficult to select breeding-lines for their suitability for winter production in WA from the selection plots of the VDPI-PBP at Toolangi. This is because these selection plots are grown under very different, summer conditions. To overcome this difficulty selection was not based solely on the breeding-lines performance. Instead we attempted to deduce the potential characteristics of the breeding-lines from their parents' attributes. This is difficult to do due to the lack of information about the parents' characteristics and the heritability of these characteristics. We attempted to select breeding-lines with a high chance of having good winter performance, potato cyst nematode resistance, light fry colour from cold soils, low levels of ACD from red soils and tolerance to blemish disease. The success of this procedure won't be known until the 2005 winter screening (Section 5.4) and a subsequent summer seed bulking are assessed.

In future one way of making more useful selections of breeding-lines for WA is to have VDPI-PBP plan crosses that will have a chance of providing the characteristics required by the WA potato industry.

Material that was selected from Toolangi was provided promptly by VDPI-PBP. Prompt delivery of the breeding-lines is important because the tubers need a quarantine bleach dip on arrival in WA and if they are sprouting damage can occur which can impair their performance when planted.

Note that the breeding lines from the VDPI-PBP that were only selected by the WA evaluation team were not cooked tested. In future WA only varieties should be cooked. This means that casual funds will have to be provided to VDPI-PBP to enable the additional sampling and cooking tests to be done. In 2005 the funding request for the

2004/05 work was not finalised at the time of sampling (April 2005!) and so the required funds were not assured and the work was not done.

6.4 District trials and demonstrations

The fresh market district trial planted in May 2004 yielded four selections new to WA. These were Victoria, 98-109-1, 99-23-11 and 00-58-1. The powdery scab disease screening trial provided susceptibility data that allowed susceptible breeding lines to be culled. The selections from the district trials (Section 5.5 & 5.6) are currently being tested in a fresh market demonstration. The demonstration will allow members of the WA potato industry to assess the selections themselves and to suggest which breeding lines should proceed to commercial testing.

Two crisp demonstrations were completed but growing conditions encountered were difficult. In the June planted demonstration selections were Atlantic, 94-28-1 and 98-10-11 while for the March planted demonstration selections were 94-28-1, 97-74-3 and 97-86-4. These selections should be re-tested in demonstrations which include the advanced line Bliss (90-2-6) to ensure they are tested under better conditions.

6.5 White Star (97-38-2)

WA growers wanted an improved winter variety that produced larger tubers than Nadine and Delaware with versatile cooking quality and tolerance to powdery scab. White Star has been delivering these benefits. We have previously discussed how commercial winter-grown tests show White Star (97-38-2) promises to deliver these improvements required to industry (Dawson & Mortimore 2004b, Mortimore *et al*. 2005).

Commercial tests produced 66 tonnes in 2004. Yields were similar to standard varieties but pack-out was superior. In 2003 White Star produced 82% Premium & Class 1 with just 9% Class 2 while Nadine had 52% Premium and Class 1 with 21% Class 2. Importantly White Star produced fewer small potatoes than Nadine. White Star had a similar pack-out advantages again in 2004 with a 16 tonne sample providing 75% Premium and Grade 1. Packers where also happy with the way the potato came through the wash-pack operations. Consumers' assessment of the taste of White Star showed 89% rated White Star's taste as good to excellent with 11% rating it as average. This was better than the comparison variety which only rated 49% with good to excellent taste and 42% with average taste.

White Star was planted in earlier, April planted, commercial trials this year (2005) and a successful result from these plantings should result in the variety being placed on the preferred variety list of the Potato Marketing Corporation of Western Australia.

White Star was bred in Australia at the National Potato Improvement Centre in Victoria by Dr Roger Kirkham. Its parents were Gladiator and the breeding-line 91-158-6. 91-158-6's parents were 86-12-17 and Atlantic. Gladiator and Atlantic are PCN resistant (either *Globodera pallida* and/or *G. rostochiensis*) so there is a better than 50% chance that White Star is also resistant to PCN. Currently White Star is being tested for resistance to PCN by the VDPI-PBP (Slater, personal communication).

Seed supplies of White Star, which were organised to support commercial testing and release, were affected by flooding in the Albany seed area. Here 250 mm of rain which fell in 36 hours, just before harvest was due, caused severe damage to seed stocks and

early generation material of White Star was lost. This will delay commercial seed production.

6.6 Auski

Auski (95-11-20) was bred at the VDPI-PBP by Dr Roger Kirkham. Its parents were Denali x 79-5-2 (Knox). In experiments reported by Dawson and Mortimore (2004a) Auski performed best in October/November plantings at Manjimup/Pemberton where it had:

- better appearance than Delaware
- better skin bloom than Delaware,
- 20% higher marketable yield than Delaware,
- equal taste to Delaware,
- lighter fry colour and large tubers that produce better fresh chips than Delaware,
- lower planting density than Delaware, but
- darker after-cooking-darkening than Delaware.

The results from the 2005 commercial tests of Auski, plus the summary above showing previous experimental findings indicate that more testing is warranted.

6.7 Billabong

Billabong's results from the 2005 commercial tests, plus the summary below of benefits identified in previous experimental results (Dawson & Mortimore 2004a), indicate that further testing of this variety is warranted.

Billabong (95-37-12) was bred by the VDPI-PBP by Dr Roger Kirkham. Its parents were Mondial x 85-30-12. Experimental results from October/November plantings from Dawson & Mortimore (2004a) show that Billabong has:

- better appearance than Delaware,
- higher specific gravity than Delaware and Nadine,
- better fry quality than Delaware and Nadine,
- better taste than Nadine,
- better post harvest skin bloom than Delaware and Nadine, but
- light yellow flesh and
- darker after-cooking-darkening than Nadine and Delaware.

6.8 Bliss

Bliss (90-2-6), a new crisp variety, offers better quality and yield and is a good example of the benefits improved varieties can provide. Bliss has 24% higher yield in October/November plantings compared with Atlantic and it also has much higher specific gravity than Atlantic (Dawson & Mortimore 2004a, Dawson *et al.* 2005). Commercial experience has confirmed the advantages that were predicted from variety experiments. Farmers in WA who have planted Bliss in December have found it has higher yield and specific gravity and less internal disorders than Atlantic and they are keen to test the variety commercially. Bliss is being grown for the export market where its high yield and good quality help increase the competitiveness of the WA potato industry.

6.9 Outcomes achieved compared with objectives

Our objective to provide the WA industry with an improved variety for winter production is well on the way to being achieved as shown by the fourth year of commercial testing of White Star. This follows three previous successful years of commercial testing of this variety.

We have also successfully completed a winter planted district fresh market trial, a powdery scab (and crocodile skin) disease screening and two crisp demonstrations, spring and autumn. A winter unreplicated screening of 2004 selections from the VDPI-PBP is due for harvest in late October 2005. A winter grown fresh market demonstration of entries selected in the district trials on 2004 is also due for harvest in late October 2005. Should White Star be unsuccessful then we have much suitable material for further evaluation for winter fresh market production.

If White Star is released then we will consult with industry through the WA variety evaluation advisory committee to determine future objectives. These will be to tackle problems that might best be solved through variety development. The breeding lines selected at the VDPI-PBP will have a broad spectrum of characteristics and should provide a good basis for selection for emerging industry priorities. The advanced summer selections of Auski and Billabong also provide material that may address future industry concerns.

7 Technology Transfer

The major technology transfer activities were:

1. The third year commercial testing of White Star for winter production for the fresh market. Harvest is currently underway and it is expected that a decision will be made on whether to add this variety to the preferred variety list of the Potato Marketing Corporation.
2. The first year of commercial testing of Auski and Billabong for summer production for the fresh market. This was held in conjunction with a "field day" at a wash-packers.
3. Two crisp demonstrations planted on a major crisp producer's crop at Lancelin.
4. An advisory committee has been established to provide the evaluation team an industry to liaise on and decide industry priorities.
5. Poster abstract and poster describing winter fresh market variety White Star for the Potato 2005 National Potato Conference (Mortimore *et al.* 2005).
6. Poster abstract and poster describing the high dry matter crisp variety Bliss for the Potato 2005 National Potato Conference (Dawson *et al.* 2005).
7. Potato Australia article describing the emerging varieties; White Star, Bliss, Billabong (Dawson & Mortimore 2005).
8. Report to the Potato Producers Committee of the APC in May 2005.

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9. Recommendations

- The current system of selecting breeding-lines from a summer planted crop at DPIPBP does not suit the selection of superior winter varieties. More information on the characteristics of the crosses is needed to help with the selection of breeding lines.
- In future crosses should be planned that will provide breeding-lines with the characteristics required by the WA potato industry. The advisory committee to the project should be consulted by FNECC before they have their discussion about crosses with the VDPI-PBP.
- Cooking tests of breeding lines selected for WA should be done at VDPI-PBP. Funds for these tests should he provided by the WA evaluators.
- Future priorities for WA variety evaluation need to be identified and suitable crosses should be planned to allow the timely production of suitable breeding-lines for testing in WA.

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11. Abbreviations & definitions

ACD	after-cooking-darkening
DPIWE	Department of Primary Industries, Water and Environment (Tasmania)
ELISA	enzyme linked immunosorbent assay
Ff	French-fry
FNECC	National Evaluation & Commercialisation Committee for the Fresh Potato Breeding Program
G	generation
ha	hectare
HAL	Horticulture Australia Limited
HRDC	Horticultural Research and Development Corporation (now HAL)
n.r.	not recommended
NaPIES	National Potato Improvement Scheme
PCN	potato cyst nematode
PLRV	potato leafroll virus
PO3	not an abbreviation, this is the name of a potato variety
PVS	potato virus S
PVX	potato virus X
PVY	potato virus Y
SG	specific gravity
t	tonnes
t/ha	tonnes per hectare
TSWV	tomato spotted wilt virus
VDPI	Victorian Department of Primary Industries
VDPI-PBP	Victorian Department of Primary Industries' Potato Breeding Program
WA	Western Australia
ware	Means the same as "fresh". Often used in young generation selections trials as its abbreviation w cannot be confused with Ff used for French-fry.