Evaluating sweetpotato varieties to meet market needs

Rodney Wolfenden
Australian Sweetpotato Growers Inc

Project Number: VG09009

VG09009

This report is published by Horticulture Australia Ltd to pass on information concerning horticultural research and development undertaken for the vegetables industry.

The research contained in this report was funded by Horticulture Australia Ltd with the financial support of the vegetables industry.

All expressions of opinion are not to be regarded as expressing the opinion of Horticulture Australia Ltd or any authority of the Australian Government.

The Company and the Australian Government accept no responsibility for any of the opinions or the accuracy of the information contained in this report and readers should rely upon their own enquiries in making decisions concerning their own interests.

ISBN 0 7341 3287 5

Published and distributed by:
Horticulture Australia Ltd
Level 7
179 Elizabeth Street
Sydney NSW 2000
Telephone: (02) 8295 2300
Fax: (02) 8295 2399

Horticulture Australia

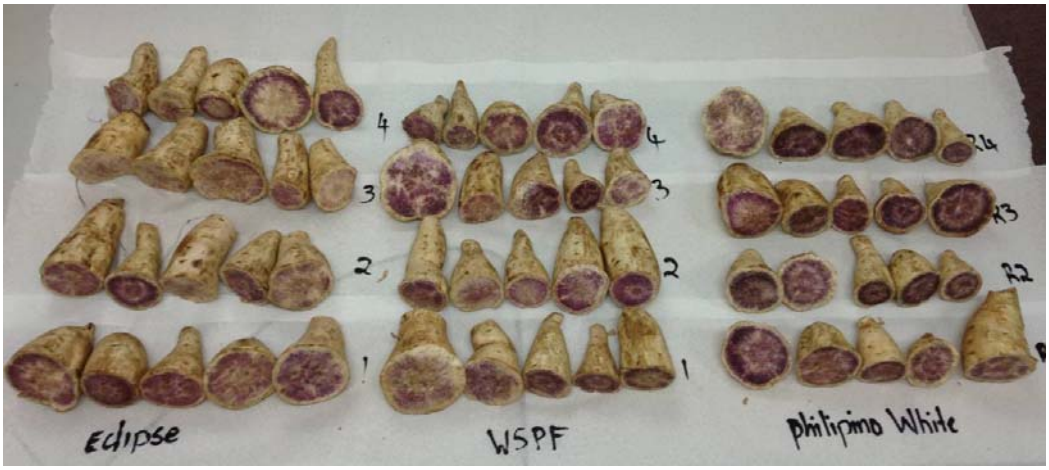
HAL Project VG09009
(Completion date 31st January 2014)

Evaluating sweetpotato varieties to meet market needs

Final Report

Rodney Wolfenden *et al.*

President; Member of the Research and Development Committee
Australian Sweetpotato Growers Inc. (ASPG)



HAL Project VG09009

Project Leader: Rodney Wolfenden
President; Member of the Research and Development Committee
Australian Sweetpotato Growers Inc. (ASPG)
P.O. Box 4350, Bundaberg South, QLD 4670

Report prepared by scientists at the Department of Agriculture, Fisheries and Forestry (DAFFQ), on behalf of ASPG.

Contact: Sandra Dennien
Ph: 07 54662225
Email: Sandra.dennien@daff.qld.gov.au

Key Research Personnel:

Sandra Dennien	(Experimentalist, DAFFQ, Gatton Research Facility)
Eric Coleman	(ASPG Research and Development Committee, Rockhampton)
Russ McCrystal	(McCrystal Consultancies, Bundaberg)
Craig Henderson	(Principal Horticulturist, DAFFQ, Gatton Research Facility
Rachael Langenbaker	(Field Assistant, DAFFQ, Bundaberg Research Facility)
William O'Donnell	(Research Assistant, DAFFQ, Gatton Research Facility)
Ron Hermann	(Research Assistant, DAFFQ, Gatton Research Facility)
Matthew Prichard	(ASPG Research and Development Committee, Cudgen)
Darren Zunker	(ASPG Research and Development Committee, Bundaberg)
Michael Jess	(ASPG Research and Development Committee, Esk)

This report summarises the process and outcomes of a three-year project, evaluating new cultivars to provide additional options for the Australian sweetpotato industry. It compares the new germplasm with current industry standard cultivars in Gold, Red, Purple and White sweetpotato categories. It provides recommendations for further research and extension of project results.

This Project has been funded by HAL using the Vegetable levy and matched funds from the Federal Government.
The research team gratefully acknowledges the generous financial support of Horticulture Australia Limited and the vegetable levy payers, the Department of Agriculture, Fisheries and Forestry (DAFFQ), and the Australian Sweetpotato Growers Inc. (ASPG). We particularly acknowledge the very generous collaborative engagement of ASPG sweetpotato growers and allied businesses, through provision of their facilities, as well as general support and encouragement".

Submitted to Horticulture Australia Limited: January 2014

HAL
Horticulture Australia

Australian Sweetpotato Growers Inc

Queensland Government

Table of contents

Acknowledgements

This project was a partnered effort between growers and support businesses in ASPG Inc., and scientific staff from DAFFQ. The synergism of those two groups working together was both productive and enjoyable, and a model that we all hope can proceed well into the future.

On the ASPG side, Rodney Wolfenden was always a pillar of support, ploughing his way through the political intricacies of project management, and always willing to espouse the RDE cause for the sweetpotato industry. Very special thanks to Eric Coleman (Aus Sweetpotato Seed), 'Mr Beauregard', for sharing his wealth of knowledge in this crop and his infectious drive and enthusiasm for all things sweetpotato. The time, effort and resources he committed to this project, given he is trying to run a growing business, was both outstanding and invaluable. Thanks also to Russ McCrystal (McCrystal Consultancies) for arranging early experimental sites and dealing with the media, joint field days and providing his experience and knowledge in sweetpotato research and development. The support of the ASPG R&D Committee (Rodney Wolfenden, Eric Coleman, Matthew Prichard, Darren Zunker, and Michael Jess) has been very helpful, as have the administrative efforts of ASPG Secretary John Maltby. The project team always felt valued, included and part of a bigger effort, rather than an add-on to other sweetpotato industry business.

The core DAFFQ scientific team consisted of Sandra Dennien, Craig Henderson, Rachael Langenbacker, William (Bill) O'Donnell and Ron Hermann. As an inexperienced project manager, it was a huge learning curve for Sandra; however, she gave this project her all. Her interest, enthusiasm and drive seldom wavered; she was the foundation around which the rest of the project effort was structured. Outstanding! Bill and Ron did many of the hard yards in the field and sheds, demonstrating the skills and calluses gained by many, many years hand-digging sweetpotato experiments. Rachel was terrific in the field as well, and was a great liaison with growers, particularly in the Bundaberg area. She also demonstrated invaluable organisational skills come Field Day time. Thanks to Craig for helping with experimental analysis and writing, as well as making himself available for extension events and general project liaison. Thanks also to Jerry Lovatt who helped with extension notes and publications.

To all the growers who let us work on their farms and looked after the experiments; who asked us the tough questions at field days and workshops, and who told us what they really thought, we are particularly grateful. Without that industry involvement, it would be too easy to get caught up in theoretical exercises, and not focus on the key issues. Your genuine interest, participation and helpful comments were a big part of us staying the distance in such a major undertaking. You made it all seem worthwhile. Special thanks to Troy Prichard, the Paddon Family, Duane Joyce, Stu and Kev Kennedy, Dave Holt, Matthew Prichard, Darren Zunker, Sam Tully, Ken Small, Brendan and Michael Petersen, Reid Tucker and Eugenio Mizzi.

Special thanks also to Dave Schofield, Steve Soderquist, Chris McManus, Ken Quade and Vince Shiewe, at DAFFQ Gatton Research Facility. The retention of sweetpotato germplasm and capacity at that site has been vital to the cause of effective sweetpotato RDE.

The Sweetpotato RDE Team

Media summary

Everybody loves Australian-grown sweetpotatoes. In 2009/10, Queensland and northern New South Wales producers marketed 850,000 cartons. Back then, you could just about guarantee the sweetpotato was a gold-skinned, gold-fleshed variety Beauregard, as it comprised 94% of the market. This dependence on one variety concerned the Australian sweetpotato industry, in case pests or diseases wiped them out. They also wanted to grow and sell new sweetpotato types, to continue to be a sustainable, profitable vegetable sector.

In 2010, Australian Sweetpotato Growers Inc. (ASPG) collaborated with scientists from the Queensland Department of Agriculture, Fisheries and Forestry (DAFFQ) and Horticulture Australia Ltd (HAL), to get new cultivars into the industry. Our project team collected 50 domestic and international cultivars, checked them for diseases, and removed any viruses we found. We then multiplied the clean planting material, and undertook extensive evaluations on ASPG grower's properties.

During the next 3 years, growers and scientists compared cultivars in detailed experiments and commercial-scale plantings around Bundaberg, Cudgen and Rockhampton, where most of Australia's sweetpotatoes are grown. At regular field days, attended by more than 80% of Australia's sweetpotato growers, scientists and industry eventually narrowed the field to the top 4-5 exciting new cultivars.

As a result, in 2014, growers are planting increasing areas of a new gold sweetpotato, Evangeline. Its size and shape are highly desired by consumers, and it has a strong, gold flesh colour. The industry also has a smooth, shapely red-skinned, white-fleshed sweetpotato, Southern Star, which performed well in evaluations. And there is excitement around new purple-fleshed cultivars Eclipse and Philipino White.

These new cultivars are not without issues. Evangeline can occasionally split, or develop a confusing red/purple colour skin, which the current market doesn't like. Likewise, Southern Star occasionally displays a less attractive bronze hued skin, whilst the purple flesh colour of Eclipse and Philipino White can be inconsistent. The industry wants to understand and overcome these issues, desiring R&D into successfully growing and marketing these new cultivars.

Industry/science partnerships will continue to drive the Australian Sweetpotato Industry forward. In the course of our project, QLD/NSW sweetpotato production has grown to 2,050,000 cartons, with 5% of production from the new cultivars. Those percentages will surely climb, as growers become more confident, and exploit their performance and market potential.

Technical summary

The Australian sweetpotato industry is experiencing remarkable growth; sales increasing by 20% per annum since 1998. The industry is currently dominated (94% of production in 2009) by a single cultivar, *Beauregard*. This reliance on a single Gold (skin and flesh) cultivar leaves the industry vulnerable to pest and disease incursions, or changing growing conditions such as global warming.

Markets are emerging for Red (red skin and white flesh) and Purple (purple flesh) categories, whilst sales of traditional White (white skin and flesh) sweetpotatoes are stagnant. Single cultivars dominate each of these categories. Variable yield and quality has limited market growth in these alternate categories.

Since 2010, Australian Sweetpotato Growers Inc. (ASPG) has collaborated with scientists from the Queensland Department of Agriculture, Fisheries and Forestry (DAFFQ), and Horticulture Australia Ltd (HAL), to address two key issues for the Australian sweetpotato industry. Firstly, reduce Gold category dependence on one cultivar; secondly, identify if suitable cultivars are available to drive market demand for Red, Purple and White categories.

Our project team curated germplasm from sweetpotato collections throughout Australia, as well as several newly imported cultivars. We pathogen-tested (PT) over 50 cultivars for known viruses. For most, we removed several viruses through cycles of heat-treating and meristem tissue and extraction, followed by indexing on *Ipomoea setosa*, accompanied by ELISA and PCR assessment. Our curation and maintenance of PT germplasm through tissue culture and mother plant collections at Aus Sweetpotato Seed in Rockhampton, and DAFFQ Gatton Research Facility, has been a major project outcome.

We surveyed growers, market agents and retailers about sweetpotato quality preferences. Common themes were a desire for consistent grades, skin and flesh colour, smooth shapes and small-medium sizes. Many marketers considered non-Gold categories risky.

In 2011, we evaluated 10 Gold, 13 Red, 8 Purple and 9 White category cultivars in comprehensive experiments at Bundaberg, Queensland and Cudgen, New South Wales where most of Australia's sweetpotatoes are grown. We monitored plant growth, storage root development, and harvested mature sweetpotatoes, grading them using commercial standards. We held major field days in both districts in late 2011, visiting the experimental sites on growers' properties. Over 80% of commercial sweetpotato growers, along with allied industry personnel, marketers and retailers attended. We collaboratively reviewed sweetpotato performance; root quality, yields, and taste. The group chose cultivars to continue evaluation in 2012, primarily based on sweetpotato quality characteristics.

In 2012, we repeated the process with 5 Gold, 4 Red, 4 Purple and 3 White cultivars, included in 3 detailed experiments and another 5 grower evaluations, where producers compared selected cultivars in their commercial blocks. A further round of well-attended field days in 2012 reviewed cultivar performance, and culled the portfolio to 4 Gold, 3 Red and 3 Purple cultivars, with no White cultivars deemed worth further assessment. In 2013, the project assisted 11 grower evaluations of remaining cultivars, with concluding field days to finalise cultivar assessments.

Our project identified a Gold sweetpotato, *Evangeline*, with size and shape highly desired by consumers, and a strong, gold flesh colour. *Evangeline* has good nematode tolerance, a very important trait for growers. *Evangeline* can occasionally split, or develop a confusing red/purple colour skin, which marketers don't like, and yields are less consistent than *Beauregard*. Another attractive Gold sweetpotato is *Bienville*; however, we found it more prone to splitting than Evangeline.

Southern Star was the most promising Red cultivar; smooth shapely, and high yielding. It occasionally displays a less attractive bronze-hued skin, and can grow too large, if not harvested early.

Our project generated considerable interest in *Eclipse* and *Philipino White* as promising cultivars with strongly purple-coloured flesh. Although they have problems with uneven shape and unpredictable flesh colour, they are no worse than *WSPF*, the current industry standard.

Targeted agronomic studies, to understand and reduce risks of splitting and off-colours, as well as maximise the yield/pack-out for *Evangeline* and *Bienville*; would assist uptake of these Gold cultivars. Similar efforts in the Red and Purple categories would also maximise cultivar performance and uptake. Even so, in 2013/14, growers have planted 5% of their crops to these new cultivars. Those percentages will surely climb, as growers become more confident, and exploit their performance and market potential.

No obvious White cultivars to replace the industry standard *Kestle* were found. The market for this category is very small; exploitation of any new germplasm would require considerable effort.

The sweetpotato industry will always need to identify and exploit new germplasm. They require an ongoing process for effectively planning and resourcing this activity, less dependent on *ad hoc*, short-term project funding. Also, improve the cultivar evaluation process, by early focus on simplified sweetpotato quality assessment, targeting more resources at fewer cultivars in the yield assessment stages.

The project team suggests that a collaborative market chain, agronomic development approach would be the best way to innovate any new cultivars into the sweetpotato industry. Introducing new cultivars requires more than successfully cropping. Allied efforts on awareness and marketing plans are needed, particularly if new cultivars are 'different' to current industry standards.

Close engagement between scientists, growers, and support industries was a particular project strength. Involvement of ASPG and their grower base meant industry directed the objectives, and took ownership of the process and the results. Doing the R&D in an industry environment encouraged growers to seek information and provide invaluable feedback. The project team very strongly recommends immersion of RDE in the target vegetable industry, as the best way to achieve practice change. Continuing this project style maintains the partnership, and develops capacity in the industry and research sectors.

Introduction

The sweetpotato industry in Australia is experiencing an ongoing period of remarkable growth, due in part to consumers attributing innate health benefits to sweetpotatoes (Gething *et. al.* 2012). Sweetpotato has high levels of antioxidants, vitamins and important dietary fibres and a low glycemic index, making it an important food in fighting obesity and diabetes.

The retail growth in the domestic Australian sweetpotato market has been based on one cultivar. This cultivar (*Beauregard*) drives the main sweetpotato category marketed in Australia i.e. gold-fleshed. Markets are emerging for Red (red skin and white flesh) and Purple (purple flesh) categories, whilst sales of traditional White (white skin and flesh) sweetpotatoes are stagnant. This research, development and extension project was initiated to address two key issues for the Australian sweetpotato industry. Firstly, reduce the Gold category dependence on one cultivar; secondly, identify if suitable cultivars are available to help increase and meet market demand for the Red, Purple and White categories.

The 100% reliance on *Beauregard* leaves the industry vulnerable to changes in the production environment due to pest and disease incursions, and changing growing conditions due to external influences like global warming. The Red, Purple and White categories are supplied by three cultivars with variable yield and quality (one in each group), which has limited market growth in these categories. Major retailers and wholesalers are requesting a reliable supply of quality sweetpotatoes in these alternate categories; however, sweetpotato growers were unable to sustain deliveries to the desired specifications.

At the commencement of this project, there were only a few well-researched cultivars in Australia. These cultivars were accessed and evaluated as part VG97053 (project commenced 1997) with some further cultivar testing performed as part of VG01010 (project commenced 2001). As part of VG01010, a large number of local cultivars were collected that had not undergone further evaluation. This meant nearly a decade has passed since the Australian sweetpotato industry has focused on identifying and evaluating cultivars to take the industry forward. The Australian sweetpotato industry does not run an active breeding program, as this is considered too expensive for a small industry to maintain. Instead the Australian sweetpotato industry obtains field cross material from growers, and imports cultivars from other germplasm collections.

At the time the project was initiated, there were at least 50 potential sweetpotato cultivars to be screened for virus and pathogen indexed. A literature review (Coleman *et. al* 2006) found no less than 300 cultivars that could be selectively accessed from the United States for evaluation by the Australian industry.

The project sought to access a broad scope of suitable sweetpotato for evaluation and run it through the pathogen-testing program to ensure materials were free from known viruses. The materials were then evaluated against the current industry standards, via regional cultivar experiments, commercial grower evaluations, and grower/wholesaler product evaluations.

The desired outcomes of the project were a sounder Gold sweetpotato supply chain, and new supply chain opportunities for Red, Purple and White categories. The end game was to increase market sustainability and growth for a vegetable crop with significant health benefits to consumers.

Surveyed international sweetpotato germplasm

At the start of the project, we reviewed global germplasm repositories, to identify cultivars that may be available internationally and could be readily imported for evaluation. We performed a desktop review of sweetpotato germplasm repositories around the world at CIP (International Potato Centre, Peru: 8000 cultivars); GRIN (Germplasm Resources Information Network, USA: 759 cultivars); SPC PAPGREN (Secretariat of the Pacific Community, Fiji: 120 cultivars); NIAS (National Institute for Agrobiological Science, Japan: 5104 cultivars) and Viazi Vitamu (Kenya: 300 cultivars). The project team already had relationships with sweetpotato breeding programs at Louisiana and Georgia State Universities, with their commercial cultivars scoped.

The Kenyan, Peruvian and Fijian collections are focussed on wild germplasm collections, and cultivars targeted at the developing world, as opposed to productive cultivars suited to large-scale, mechanised production systems. Investigations suggested it would be difficult and time-consuming to access/ import materials from the Japanese collection.

For this project, promising germplasm from the Louisiana State University breeding program was targeted and requested for importation, involving collaborative licensing and evaluation agreements.

Assembled germplasm materials

We sourced germplasm (commercial and experimental cultivars) from collections throughout Australia, including:

- Redlands and Gatton Horticultural Research Stations, Queensland. Both in-vitro and field collections, developed from Lester Loader's previous North Queensland Collection and Peter Beetham's ACIAR Collection (originating in the South Pacific and Japan), as well as various local types collected during previous research activities.

- Bundaberg Research Station, Queensland. In field, 'dirty' collection of materials specifically discovered during visits to Australian sweetpotato growing regions as part of VG01010.

We also purchased a cultivar via the internet from an Australian supplier, originally thought to be sourced from America.

Finally, we also successfully imported (via AQIS) four cultivars from the Louisiana State University breeding program.

We initially selected a total of 49 cultivars, based on previous performance and inherent knowledge, for evaluation during the project. We have grouped these into four categories, GOLD, RED, PURPLE and WHITE, as shown below. The industry standard cultivar in each category is listed first.

Table 1 Gold category - cultivars with gold or red/gold skin and gold flesh.

Cultivar name	Skin colour	Flesh colour	Collection	Origin
Beauregard	Gold	Gold	Reference commercial cultivar	USA
Excel	Pale Gold	Gold	New Import	USA
Darby	Gold	Gold	Existing cultivar	USA
Cudgen Gold	Gold	Gold	Existing cultivar	Australia
Hernandez	Gold	Gold	Existing cultivar	USA
Bienville	Red/Gold	Gold	New Import	USA
Evangeline	Red/Gold	Gold	New Import	USA
B63	Gold	Gold	New Import	USA
Bundy Gold	Gold	Gold	Existing cultivar	Australia
Regal	Purple/Red	Gold	New Import	USA
LO-323:8	Gold	Gold	Existing cultivar	USA
Centennial	Gold	Gold	Existing cultivar	USA
NC-3:9	Gold	Gold	Existing cultivar	USA

Table 2 Red category - cultivars with red or red/purple skin and white flesh.

Cultivar name	Skin colour	Flesh colour	Collection	Origin
Northern Star	Purple/Red	White	Reference commercial cultivar	Papua New Guinea
Q95-3:1	Pink/Purple	White	Existing cultivar	Australia
L46 (Alotau, IB062)	Pink/Purple	White	New selection	Papua New Guinea
L11 (Koitaki 2, IB023)	Pink/Purple	White	New selection	Papua New Guinea
Wanmun	Pink/Purple	White	New selection	Papua New Guinea
NG7570	Purple/Red	White	New selection	Nigeria
JRW	Purple/Red	White/cream	Existing cultivar	Australia
Southern Star	Purple/Red	White	New selection	Australia
Smith's Red	Purple/Red	White	New selection	Australia
Kate	Purple/Red	White	New selection	Australia
Red Red	Purple/Red	White	New selection	Australia
Murasaki	Purple/Red	Cream/yellow	New Import	USA
Beni Aka	Red	White/cream	New selection	Japan
Hung Loc	Red	Yellow	Existing cultivar	Vietnam
Beni Kokei	Red	White/cream	New selection	Japan
Rose	Red	White	New selection	Australia
L131	Purple/Red	White	New selection	Papua New Guinea

Table 3 Purple category - cultivars with white or purple skin and white/purple flesh.

Variety name	Skin colour	Flesh colour	Collection	Origin
WSPF	White	White/purple	Reference commercial variety	Australia
Molokai Purple	Dark purple	Purple	New Import	USA (Origin Hawaii)
Alley's White	White	White/purple	New selection	Australia
Philipino White	White	White/purple	New selection	Australia
Hawaii Tonga	White	White/pale purple	New selection	Tonga
Hawaii V	White	White/pale purple	Existing variety	Australia
Eclipse	White	White/purple	New selection	Australia
Lola Tonga	Pale purple	Cream/ pale purple/ pink	New selection	Tonga

Table 4 White category - cultivars with white skin and white flesh.

Cultivar name	Skin colour	Flesh colour	Collection	Origin
Kestle	White	White	Reference commercial cultivar	Australia
L135 (Nomad 6, IB098)	White/Tan	Cream/yellow	New selection	Papua New Guinea
Meriken	White	Cream/yellow	New selection	Papua New Guinea
Markham	White	Pale orange/yellow	New selection	Papua New Guinea
Snowhite	White	White	New selection	Australia
L49 (Woksaken, IB032)	White	White	New selection	Papua New Guinea
Sumor	White/Cream	White	New Import	USA
Colleambally	White	White	Existing cultivar	Australia
L3 (Higaturu, IB269)	White	White	New selection	Papua New Guinea
Whitestar US	White	White	New Import	USA
Blackie	White	White	New selection	USA

Summary cultivar notes

Gold category

Beauregard: (L82-508): *Beauregard* (Imported from the USA) is the current Australian industry standard gold-fleshed cultivar making up around 95% of Australian sweetpotato production. *Beauregard* has a rose/gold smooth skin, with a moderately deep orange flesh. It was developed by the Louisiana Agricultural Experiment Station in 1981, with female lineage of L8-21, L0-197, L7-29 and L9-89. *Beauregard* was pathogen tested and re-released in Queensland as virus-free planting material (as part of VG97023) in 2000. This cultivar is consistently high yielding in a range of soil types and under most conditions, with good shape. According to the cultivar release notes, it is resistant to Fusarium wilt, and Rhizopus soft rot; moderately resistant to Soil rot and Sclerotial blight. It is however very susceptible to Root knot nematode and Bacterial root rot.

B63: This cultivar is a *Beauregard* mericlone, with a similar rose/gold smooth skin and moderately deep orange flesh. *B63* was imported into Australia by Eric Coleman in 2009, and was released from quarantine in 2010. It is resistant to Fusarium wilt, soil rot, and Rhizopus soft rot; moderately resistant to Soil rot and Sclerotial blight. It is however very susceptible to Root knot nematode and Bacterial root rot.

Bienville: (L94-96): It usually has a rose red skin, with uniform moderate orange to dark orange flesh colour. It was developed by the Louisiana Agricultural Experiment Station in 1994, as a seedling from an 11 parent poly-cross nursery. The female lineage is L86-33 and L82-508 (*Beauregard*). *Bienville* was imported into Australia by Eric Coleman in 2009, and released from quarantine in 2010. *Bienville* is resistant to Root knot nematode, Fusarium wilt, Fusarium root rot and Rhizopus soft rot; moderately resistant to Bbacterial root rot.

Bundy Gold: This cultivar has a rose/gold smooth skin, with even orange flesh. It was collected by Eric Coleman and William O'Donnell from sweetpotato grower Dave Fisher in Bundaberg in 2001, and is likely to be a variant of *Beauregard*.

Centennial: (L3-77): This cultivar has a bright, copper/ gold skin colour with orange flesh, and was released by the Louisiana Agricultural Experiment Station in 1953. It was originally named in recognition of Louisiana State University's 100 years of service. It was first imported into Australia and released into Queensland in 1975. *Centennial* was a popular gold-fleshed cultivar, prior to the import of *Beauregard*.

Cudgen Gold: This cultivar has a rose/gold smooth skin, with even orange flesh. It was collected by Eric Coleman and William O'Donnell as a selection with Cudgen growers in 2001. It is likely a variant of *Beauregard,* possibly originating from the NSW Department of Agriculture. In observations, it is certainly susceptible to Root knot nematode.

Darby: (Q87-59): This cultivar has a red dark gold/ red skin with smooth skin and orange flesh. It was developed by the Louisiana Agricultural Experiment Station in 1987, as a seedling from a poly-cross nursery. The female lineage is L83-523 and W-151 (*Southern Delite*). The time of its import into Australia is unclear. It was grown extensively in Australia prior to the release of *Beauregard*. The roots of *Darby* can be prone to breakdown in storage.

Evangeline: (L99-35): This cultivar has a deep red/gold skin, with intense orange flesh colour. It was developed by the Louisiana Agricultural Experiment Station in 1999, as a seedling from a poly-cross nursery. The female lineage is L94-96 (*Bienville*) and L82-508 (*Beauregard*). *Evangeline* was imported into Australia in by Eric Coleman in 2009, and released from quarantine in 2010. It apparently has less propensity to produce large-sized storage roots than *Beauregard*, with total sugars one third higher than *Beauregard* (Labonte pers. comm.). In contrast with *Beauregard, Evangeline* is supposed to be highly resistant to Root knot nematode. It is resistant to Fusarium wilt, Fusarium root rot and Rhizopus soft rot; moderately resistant to Soil rot; and susceptible to Sclerotial blight. *Evangeline* is also more tolerant to waterlogging than *Beauregard*. *Evangeline* was released in Louisiana in response to Hurricane Katrina.

Excel: This cultivar has a pale orange skin with larger lenticels than *Beauregard* does, and an even, orange flesh. It was developed jointly by Clemson University (South Carolina) and the U.S. Department of Agriculture. *Excel* was imported into Australia by Russ McCrystal in 2007. It is thought to have high resistance to Root knot nematode, and a degree of tolerance to soil insects.

Hernandez: (L82-66): This cultivar has a copper skin colour, with intense orange flesh colour, and was developed by the Louisiana Agricultural Experiment Station in 1982. Its female lineage is L70-323. The time of its import into Australia is unclear; introduced into Queensland by Lester Loader. *Hernandez* is later developing than *Beauregard,* and is moderately resistant to Soil rot, Root knot nematode, Fusarium wilt and Root rot. It is however susceptible to Bacterial root rot and Rhizopus soft rot.

LO-323:8: This cultivar has a light orange skin and a mid orange flesh with darker orange areas. It was released by the Louisiana Agricultural Experiment Station in 1976, imported and released into QLD in 1981. Although there were originally several selections released, we used the one maintained by Lester Loader late last century.

NC-3:9: This cultivar has a bright copper/ gold skin colour and orange flesh. It was imported from North Carolina as a breeder line in 1977, and released in QLD in 1981. Although there were originally several selections released, we used the one maintained by Lester Loader late last century.

Regal: This cultivar has a red/ purple skin, and orange flesh. It was developed jointly by Clemson University (South Carolina) and the U.S. Department of Agriculture. *Regal* was imported into Australia by Russ McCrystal in 2007. It is thought to be resistance to Root knot nematode, and have a degree of tolerance to soil insects.

Red category

Northern Star: (L258): This cultivar has a red/purple (fuchsia) double skin and bright, white flesh, with occasional small, purple star-shaped areas. It was collected by Peter Beetham at Laloki Research Station (Morobe province, Menyamya district, Papua New Guinea) between 1985 and 1992. It was initially selected out by Lester Loader from the collection (ex Victoria) at Redlands Research Station. This is the dominant Red cultivar marketed in Australia; however, it is prone to rapid growth, leading to growth cracks, and/or misshapen, oversize storage roots.

Beni Aka: This cultivar has a red/purple skin with white flesh, and was imported from Japan in 2003.

Beni Kokei: This cultivar has a red/purple skin with cream/yellow flesh, and was imported from Japan in 2003.

JRW: This cultivar has a red/purple single skin, with cream/yellow flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. We believe it was originally obtained from a grower by Lester Loader, and is possibly of Japanese origin.

Hung Loc 4: This cultivar has a purple (fuchsia) skin and, yellow flesh with orange areas. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally imported by Peter Beetham from CIP (originally collected in Vietnam). Its ACIAR Accession number is 120.

Kate: This cultivar has a red/purple (fuchsia, with occasional bronze hue) double skin and bright, white flesh, with occasional small purple areas. It was selected as one of the lines from a plant collected by Eric Coleman in 2004 from John Julius in Cudgen. This cultivar has very good storage root shape and keeping quality. It may have originated as a cross between *Beauregard* and *Northern Star*.

L11: (Koitaki 2, IB023): This cultivar has a red/purple single skin, with cream flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham in Sogeri district (Central Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 57330116.

L131: (IB071, Nomad 2, K30, Halasika, IB203): This cultivar has a purple (fuchsia) single skin, with white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham in Nomad district (Western Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 585105.

L46: (Alotau, IB062): This cultivar has a red/purple double skin, with white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham in Alotau district (Milne Bay Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 564137.

Murasaki-29: (L0-29): This cultivar has a dark purple, single skin, with cream flesh. It was developed by the Louisiana Agricultural Experiment Station in 2001, as a seedling from an open-pollinated poly-cross nursery. Eric Coleman imported this cultivar into Australia in 2009; released from quarantine in 2010. The female lineage is L89-72, from L87-501, from L82-509, from W-151 (*Southern Delite*). Murasaki is a late developing cultivar; highly resistant to Root knot nematode and Rhizopus soft rot; resistant to Fusarium wilt and Root rot and moderately resistant to Soil rot.

NG7570: This cultivar has a red/purple single skin, with white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham at Dodo Creek Research Station, (IIta Province, Solomon Islands) between 1985 and 1992. It was previously imported from Nigeria; possibly a CIP line.

Q953-3:1: This cultivar has a single red-brown skin with white flesh. It was one of Lester Loader's breeding lines, selected at Southedge Research Station, Mareeba (QLD) over 30 years ago.

Red Red: This cultivar has a red/purple (fuchsia) double skin and bright, white flesh, with occasional small purple areas. It was selected as one of the lines from a plant collected by Eric Coleman in 2004 from John Julius in Cudgen. This cultivar has very good storage root shape and keeping quality.

Rose': This cultivar has a pink/tan skin with white flesh. It was collected by Eric Coleman and William O'Donnell in Northern NSW in 2001, possibly originating from the NSW Department of Agriculture.

Smith's Red: This cultivar has a red/purple double skin with white flesh. Sandra Dennien collected this cultivar in Dimbulah, Queensland in 2006.

Southern Star: This cultivar has a red/purple (fuchsia, with occasional bronze hue) double skin and bright, white flesh, with occasional small purple areas. It was selected as a tissue culture variant of *Kate* in 2009. It may have originated as a cross between *Beauregard* and *Northern Star*.

Wanmun: (Wanmun Small, Wanmun Large, Wanmun Kabiufa). This cultivar has a pale red/purple single skin, sometimes tending to pale tan at the distal end, with cream/white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham in Aiyura district (Eastern Highlands Province, Papua New Guinea) between 1985 and 1992.

Purple category

WSPF: (White Skin, Purple Flesh): This cultivar has a white skin with white and purple flesh. Its origins are unclear, however it was pathogen tested and released in Queensland as virus free planting material (as part of VG97023) in 2000. It is currently the principal purple category cultivar grown for the commercial Australian sweetpotato market.

Alley's White: This cultivar has a white skin, with white and purple flesh. It was originally collected by Eric Coleman and William O'Donnell, from a farmers market in Cairns, Australia in 2001.

Eclipse: This cultivar has a white skin, with white and purple flesh. It was collected by Eric Coleman and William O'Donnell in Northern NSW in 2001, possibly originating from the NSW Department of Agriculture.

Hawaii Tonga: This cultivar has a white skin, with white and variable/pale purple flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was imported by Peter Beetham from Tonga (originally collected in Vaini Research Farm Tonga, from Tongatapu, Tonga). Its ACIAR Accession number is 1.

Hawaii V: This cultivar has a white skin, with white and purple flesh. It may simply be another collection of *Hawaii Tonga*, re-sourced from the original Victorian collection of Peter Beetham.

Lola Tonga: This cultivar has a translucent purple/tan skin, with white and pale purple/pink flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was imported by Peter Beetham from Tonga (originally collected in Vaini Research Farm Tonga, from Tongatapu, Tonga).

Molokai Purple: This cultivar has a deep purple skin, and an even purple flesh with a white cortex. It was imported by Eric Coleman into Queensland in 2007; thought to have originated at Molokai Island, Hawaii.

Philipino White: This cultivar has a white skin, with white and purple flesh. It was originally collected by Eric Coleman and William O'Donnell, from Miara (near Bundaberg), Australia in 2001.

White category

Kestle: (CN-1489-89): This cultivar has a white skin, with white flesh. The original material came from Taiwan, with the resultant selection by Lester Loader named after himself, and other members of the then sweetpotato team, Ken Jackson and Stuart Scott, 20-30 years ago. It is currently the principal white category cultivar grown for the commercial Australian sweetpotato market.

Blackie: This cultivar has a white skin, with white flesh. It was an ornamental type, advertised on the internet in Australia, and procured in 2009.

Colleambally: This cultivar has a white skin, with white flesh. Its origins are unclear; however, it was grown in NSW for many years. The selection used in this project was collected in 1984 from the NSW Dept of Agriculture Research Station at Alstonville, NSW.

L3: (Higaturu, IB 093): This cultivar has a white skin, with white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham at Popondetta district (Northern Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 564132.

L49: (Woksaken, IB 032): This cultivar has a white skin, with bright, white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham at Kiunga district (Western Province,, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 573287, and possibly PI 585058.

L135: (Nomad 6, IB 098): This cultivar has a tan skin, and cream/yellow flesh with areas of orange. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham at Nomad District (Western Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 564139.

Markham: This cultivar has a white skin, with cream/white flesh. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham at Aiyura Research Station (Eastern Highlands Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 564149.

Meriken: This cultivar has a tan skin, and cream/yellow flesh with areas of orange. We transferred it to Gatton Research Station in 2005, as part of Lester Loader's collection held at Redlands Horticultural Research Facility. It was originally collected by Peter Beetham at Aiyura Research Station (Eastern Highlands Province, Papua New Guinea) between 1985 and 1992. Its USDA reference number is PI 585111.

Snowhite: This cultivar has a white skin, with bright, white flesh. It was collected by Eric Coleman and William O'Donnell in August 2001, from the property of sweetpotato grower Phil Buchannan at Mango Hill, Queensland. It is a long, slightly ribbed sweetpotato, which grows well in sandy soils.

Sumor: (W-201): This cultivar has a light tan skin colour, with white/cream flesh. It was developed jointly by Clemson University (South Carolina) and the U.S. Department of Agriculture in 1984. *Sumor* was imported into Australia by Russ McCrystal in 2007. It presents as relatively sappy, with a dry matter content of 27 to 30%. It produces small to medium sized roots with uniform shape. In the USA, *Sumor* is supposed to be highly resistant to Southern root knot nematode, Southern potato wire worm, Tobacco wireworm, Cucumber beetles, Flea beetles and White grub.

Whitestar US: This cultivar has a light tan skin colour, with white/yellow flesh. It was imported by Eric Coleman from the USA in 2007. The storage roots are sappy on cutting.

Derived pathogen-tested germplasm

We completed a pathogen-testing program at Gatton Research Facility for all the assembled germplasm. This was necessary as cultivars were either:

- Collected from the field and therefore potentially infected with viruses
- Previously held in (dirty) collections in open glasshouses and therefore possibly exposed to virus infection by insect vectors
- Stored in-vitro, and had not been pathogen tested for many years; in some cases since the early 1990's

Additionally:

- New viruses not previously known to exist in Queensland had recently been identified in cultivars from the Queensland sweetpotato germplasm collection in-vitro
- It was unclear at the time whether AQIS had tested new imported cultivars for more recently discovered sweetpotato viruses

Virus testing

We subjected all cultivars to the following processes:

Virus indexing

We initially established *Ipomoea setosa* seedlings in individual pots containing pasteurised potting mix (1/3 washed river sand, 1/3 peat, 1/3 Pearlite and trace elements), grown in an insect proof glasshouse for 3-4 weeks in summer. For each cultivar, sweetpotato cuttings from both old and new (tip) vine growth were grafted onto *I. setosa* using both an end cleft graft, and a side veneer graft for each *I. setosa* plant. This was replicated five times for all sweetpotato cultivars to be tested.

The *I. setosa* plants were observed every other day for 6 weeks for the presence of virus symptoms, continuing once a week for the following 3 weeks for the presence of phytoplasma symptoms.

Indexing onto *Ipomoea setosa* is currently the most reliable and cost effective method for detecting virus (including Begomovirus) and phytoplasma in sweetpotato, if carried out by staff skilled in sweetpotato virus identification techniques.

Serology using ELISA

Serology (NCM ELISA) used specific antibody tests for 10 known sweetpotato viruses, developed by CIP (International Potato Centre, Lima, Peru). These included:

Sweetpotato feathery mottle virus (SPFMV), Sweetpotato mild mottle virus (SPMMV), Sweetpotato mild speckling virus (SPMSV), Sweetpotato latent virus (SPLV), Sweetpotato caulimo-like virus (SPCaLV), Sweetpotato chlorotic stunt virus (SPCSV), Sweetpotato chlorotic fleck virus (SPCFV), Sweetpotato virus G (SPVG), Cucumber mosaic virus (CMV) and C-6.

We collected leaf samples from the top, middle and base of the *I. setosa* plants two-three weeks after grafting. We then conducted standard ELISA testing procedures for sweetpotato viruses, as outlined in Dennien *et. al.* (2013).

PCR testing

We also tested some samples for known viruses using PCR (Polymerase chain reaction) for the presence of viruses from the Potyvirus family; SPFMV, Virus G, Phytoplasma and Begomovirus using known protocols and primers sourced from CIP sweetpotato virologist Segundo Fuentes in Peru. This methodology is described in detail in Dennien *et. al.* (2013).

Testing results

If the initial virus testing proved negative, i.e. we detected no virus symptoms using all the above methodology, we repeated this testing twice more. If test results were negative on all three occasions, we deemed the cultivar free of known viruses. Consequently:

- Existing cultivars were labelled as Pathogen-tested (PT) and returned to the germplasm bank to be stored in vitro
- New cultivars were placed into tissue culture and added to the sweetpotato germplasm bank

If the initial virus testing was positive, i.e. any of the tests suggested viruses were present, then that germplasm was subject to heat treatment or thermotherapy for seven weeks, to remove viruses. Plants were either placed into thermotherapy in pots, or initiated into tissue culture by placing single node disinfested cuttings into culture media, Ms 519 (Murashige and Skoog), in glass honey jars and thermo-treated in vitro.

Plants in pots multiplied from cuttings and kept in a glasshouse in summer (average temperature 29 ^{0}C) were subjected to one week at 29 ^{0}C, one week at 34 ^{0}C and four weeks at 39 ^{0}C.

Plants placed into tissue culture thermotherapy in vitro were subjected to two weeks at 29 ^{0}C, one week at 34 ^{0}C and four weeks at 39 ^{0}C.

After heat treatment, we removed tip cuttings from treated plants and extracted meristem cells, which we then placed into tissue culture. The resulting in-vitro plantlets were then de-flasked after two to three months, hardened for a further 3 months, and again subjected to the pathogen testing described in the previous procedure.

As before, those treated plantlets returning a negative result on three occasions were deemed free of known viruses and added to the gene bank.

We subjected cultivars continuing to produce positive results to another round of thermotherapy and subsequent follow up virus testing.

Although on most occasions we generated virus-free material, some results indicate the continued presence of a newly discovered persistent Begomovirus, which proved difficult to remove in the time frame of this project.

Bulked planting material for first stage evaluations

We initially bulked up Pathogen Tested (PT) tissue culture plantlets of the 49 selected cultivars in vitro. After approximately 3 months growth, we de-flasked these plants, and transferred them into individual planting tubs in an insect screened (quarantine meshed) tunnel house at Gatton Research Facility in February 2010, as the primary source for PT cuttings.

We sourced standardised tip cuttings 30-35 cm long with 3 nodes in the 15 cm of the cutting proximal to the tip (Fig. 1) from these mother plants in April 2010.

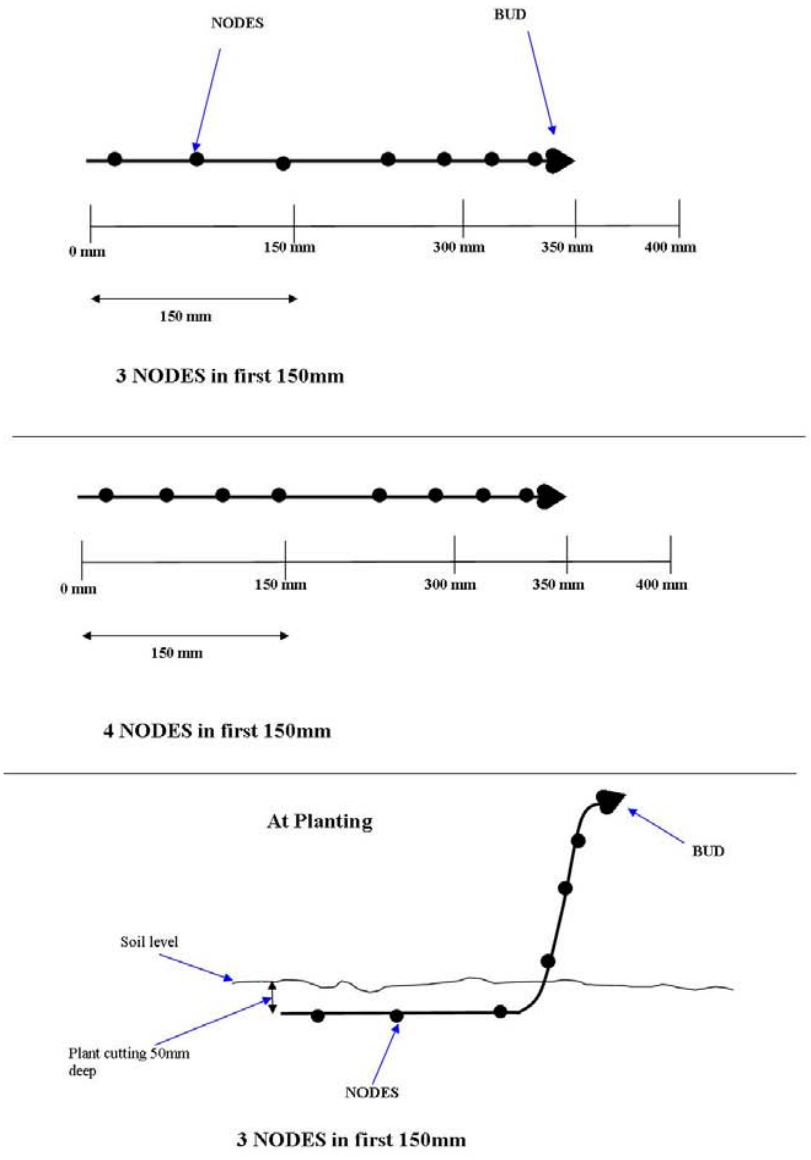


Figure 1 **Process for selecting, standardising and planting premium sweetpotato tip cuttings.**

We then transported them to Bowen Research Facility, for inclusion in a multiplication experiment, with 3 replicates in a randomised complete block design. Each plot was 3-10 m long (depending on the number of initial cuttings available) and 1 row wide, with an inter-row spacing of 1.5 m. We planted cuttings 30 cm apart, and grew them using standard grower agronomy (irrigation, nutrition, pest management). We harvested mother roots from this multiplication experiment in November 2010, and transported them back to Gatton Research Facility. We collected basic data, including the number of roots produced, as well as shape, weight, skin / flesh colour and dry matter content of those roots.

We planted the 49 individual cultivar root harvests into separate plantbeds for further multiplication and supply of experimental cuttings for evaluation. The plantbed production technique is described in detail in Dennien *et. al.* (2013). We observed vine top growth for vigour, habit and susceptibility to insect pests, bacterial and fungal diseases during the life of the plantbeds.

Taking into account the bulking up phases at Bowen Research Facility, and early plantbed growth observations at Gatton Research Facility, we reduced the portfolio of cultivars to be assessed in further studies from 49 to 40.

In the Red and White categories, *Beni Aka, Hung Loc, Beni Kokei, Rose', Blacky,* and *L131* produced very low numbers of roots, and these roots were commonly pencil, fibrous or very small, and misshapen. Given the large number of cultivars already in this category, in consultation with ASPG members, we culled the above from further evaluation.

To further reduce the portfolio of cultivars to a manageable size, we also culled Gold category cultivars *LO323:8, NC-3:9* and *Centennial*, as in previous evaluation projects (20-30 years ago), they had already been extensively compared with *Beauregard*. They had consistently demonstrated inferior production of quality roots compared to this industry standard.

Initial grower survey

Early in the project, we baseline surveyed Queensland and New South Wales sweetpotato growers, to obtain an understanding of their productions levels, and key issues. We posted written surveys to the ASPG database, with follow up phone calls and discussions at farm visits to maximise response rates. We quantified their plantings of each sweetpotato category, and cultivars within category, at the commencement of the project. Our intent was to be able to assess any changes at project completion.

We surveyed a large cross section of growers covering small, medium and large enterprises in the main sweetpotato production areas in Queensland and New South Wales, comprising over 80% of the Australian sweetpotato industry. This survey also assessed grower's attitudes to production limitations pertaining to agronomic factors like climate, pest and disease tolerance and possible environmental impacts.

Survey results

Production statistics

Area planted

Of the growers surveyed, the total number of hectares of sweetpotatoes planted increased by around 3% in 2010-11 compared to the previous year (Fig. 2). The proportion of segmentation into Gold, Red, Purple and White categories was very consistent in those two years at the start of the project, dominated by the industry standard cultivars in each category (Table 5). The dominant position of Gold category (80%) is clearly demonstrated, with the bulk of the remaining sweetpotato land devoted to Reds, and very little planted to Purple or White categories. These latter two categories are generally targeted at local sales, or specialty grocers.

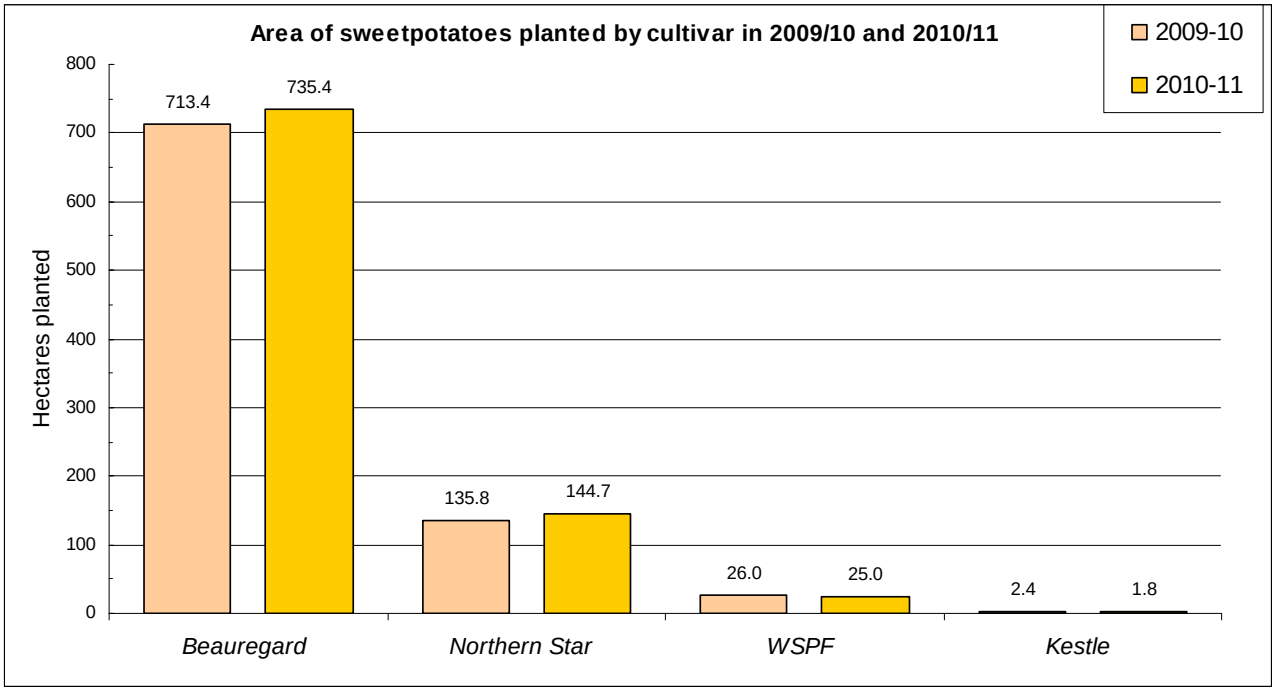


Figure 2 **Areas of Gold, Red, Purple and White sweetpotatoes planted in QLD and NSW in 2009-2011.**

Table 5 **Proportion of Gold, Red, Purple and White sweetpotatoes planted in QLD and NSW in 2009-2011.**

		Sweetpotato plantings (%)	
Sweetpotato category	**Cultivar**	**2009-2010**	**2010-2011**
Gold	*Beauregard*	79.4	83.1
Red	*Northern Star*	13.6	14.9
Purple	*WSPF*	2.7	2.6
White	*Kestle*	0.2	0.2

Sweetpotato production

There was a major increase in production of Gold and Red sweetpotatoes from 2009 to 2011 (Fig. 3). In contrast, the production of Purple and White sweetpotatoes changed very little, with in fact a substantial decrease of White sweetpotatoes sent to market.

Gold category (*Beauregard*) was 90-95% of production, with Red category (*Northern Star*) the bulk of the remainder; the Purple and White categories combined comprising only 1% of production (Table 6).

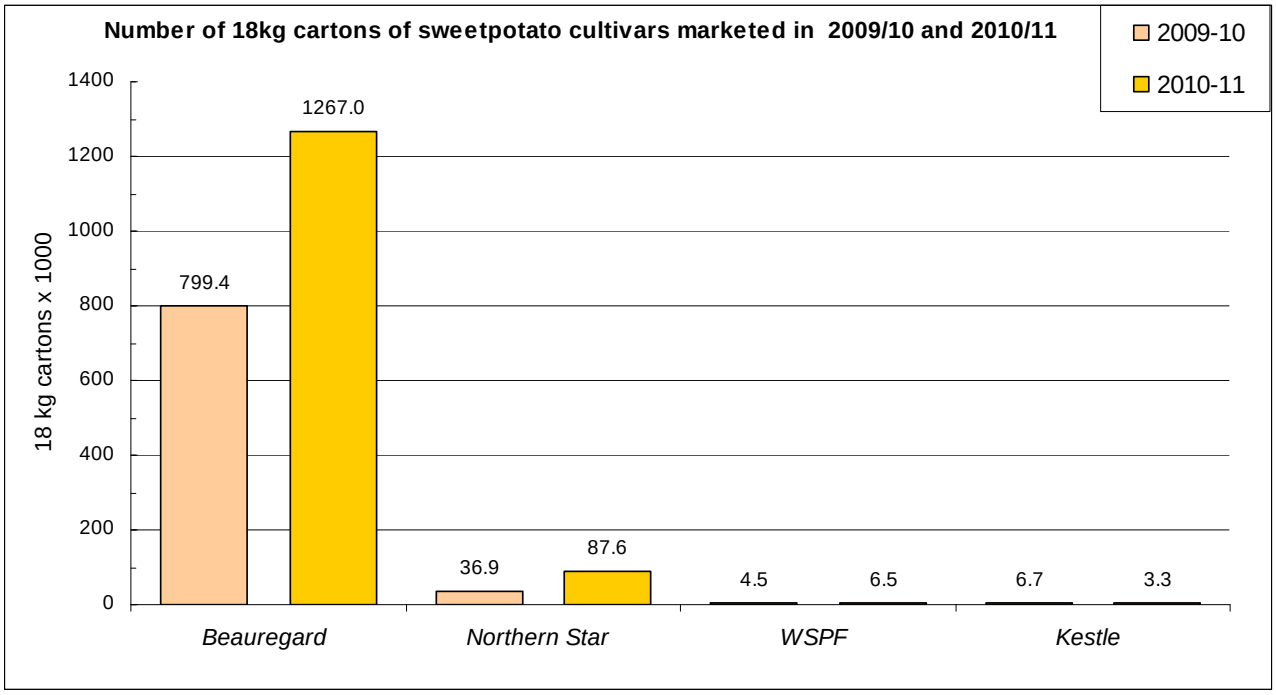


Figure 3 **Production of Gold, Red, Purple and White sweetpotatoes marketed (number of 18 kg cartons) by QLD and NSW growers in 2009-2011.**

Table 6 **Proportion of Gold, Red, Purple and White sweetpotatoes marketed by QLD and NSW growers in 2009-2011.**

		Sweetpotato cartons marketed (%)	
Sweetpotato category	**Cultivar**	**2009-2010**	**2010-2011**
Gold	*Beauregard*	94.3	92.9
Red	*Northern Star*	4.4	6.4
Purple	*WSPF*	0.5	0.5
White	*Kestle*	0.8	0.2

Sweetpotato grower attitudes in 2009

According to the initial surveys, 29% of growers nominated varietal/physiological defects such as cracking, poor uneven shape, pale skin and flesh colour, twisted and bumpy roots; low yields; and poor performance in cool weather; as the most important variables affecting their sweetpotato productivity and economic performance (Fig. 4).

A similar proportion said environmental factors were most important; including wet growing seasons; dry weather at planting then high rainfall later in the growing season; soil erosion; waterlogging and inability to apply pesticides leading to pest damage and low yields.

Another quarter of growers decried pests as their most critical issues, with approximately half specifically indicated that nematodes were a limiting factor, with an additional 15% concerned about diseases.

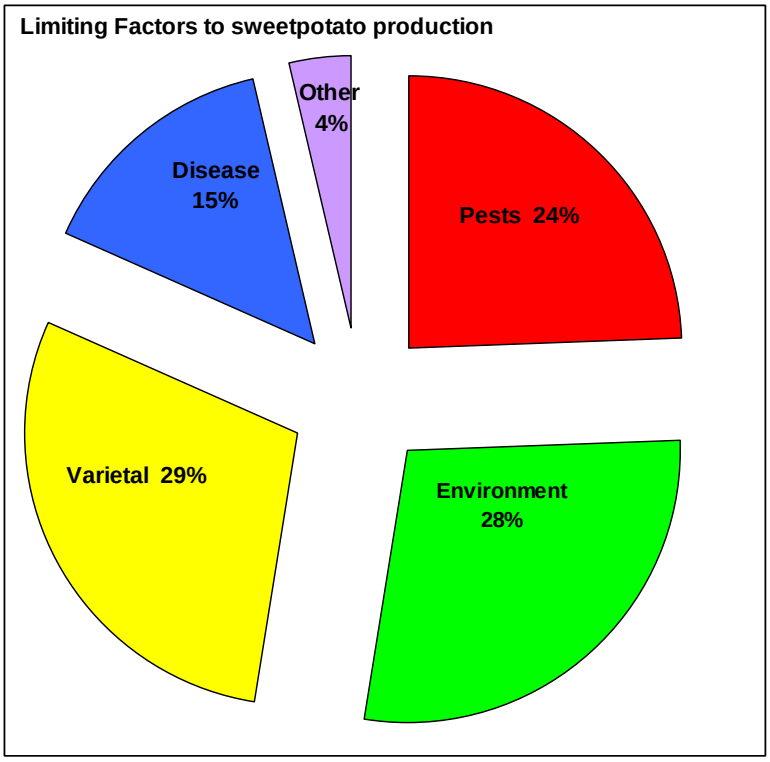


Figure 4 **Prioritisation of agronomic issues by sweetpotato growers in QLD and NSW in 2009.**

Initial market survey

In 2010, we surveyed wholesalers of sweetpotatoes in all the capital city markets, as well as major buyers for each of the supermarket chains and high-end, gourmet grocers. We garnered information from a total of 26 respondents in this cohort. We sought to find out the key attributes they were looking for in sweetpotatoes for their markets, as well as any issues that would affect their buying decisions.

Responses

Merchants, agents and supermarket buyers

What they said they want (1 being most important)

1. Shape - smooth, even shape
2. Size -medium and small-medium (dumpy); large only for processing and restaurants
3. Skin - smooth, dark or intense colour, pink blush, shiny
4. Freshness - firm and unblemished
5. Clean - free of all dirt
6. Properly graded boxes – occasionally extra premiums for ‘perfect’ grades

What they said they don’t want (1 being most disliked)

1. Shape - Twisted, bumpy, long and skinny shapes; for large sizes, a chopped tail no larger than a 50c piece
2. Size - thin small mediums
3. Skin - rough, dull or pale colour
4. Damage of any sort
5. Soil on skin - especially grey soil
6. Unevenly graded boxes

Large independent and specialist fruit and vegetable retail stores

What they said they want (1 being most important)

1. Size - medium, and small-medium
2. Shape – 18 to 25 cm long, not more than 5 cm diameter
3. Skin - smooth, with a rich, vibrant colour and shiny skin
4. Freshness – require firm and unblemished
5. Clean - free of all dirt
6. Properly weighted boxes

What they said they don’t want (1 being most disliked)

1. Size - Large sweetpotatoes
2. Shape - Twisted, bumpy, long and skinny shapes
3. Skin – pitting; dirty, dull or pale skin colour
4. Old product - dull, dry, cracking, or soft sweetpotatoes, refrigerated sweetpotatoes
5. Damaged roots – insect or mechanical damage
6. Over-packed boxes

Other information and comments gained from survey

- Most marketers indicated 95% sweetpotatoes sold are Gold category
- Most sweetpotato demand is in cooler months
- Marketers indicated the community had little knowledge about different cooking methods
- Only about 60% of retailers were aware of flesh colours other than Gold
- Different flesh colours are sold under many different names:
    - Gold category – Gold, Red
    - Red category– Kumara, Purple, Red, White, Old European White
    - Purple category - Hawaiian, White, and Purple
    - White category - White
- Marketers that sold other flesh colours said that quality and quantity were the main problems, both being inconsistent and often poor. Buying is often considered a risk
- Demand for good Purple sweetpotatoes outstrips supply
- Retailers aware of colour categories stated the majority of their consumers wouldn't know how to best cook non-Gold sweetpotatoes, or use them in recipes
- The exception to the above are people with Asian or Pacific Island backgrounds, who often prefer non-Gold categories for a range of reasons – taste, mouth feel, consistency and sweetness
- Demand for White category sweetpotatoes has declined substantially in the last 30 years

Initial detailed cultivar evaluation experiments in 2011

For the first field stage of the project, we undertook initial screening experiments to reduce the number of cultivars to a manageable number. These experiments assessed 40 sweetpotato cultivars in the 4 distinct skin/flesh combinations:

- 10 Gold category cultivars – *Beauregard, Excel, Darby, Cudgen Gold, Hernandez, Bienville, Evangeline, B63, Bundy Gold, Regal;*
- 13 Red category cultivars – *Northern Star, Q95-3:1, L46 (Alotau, IB062), L11 (Koitaki 2, IB023), Wanmun, NG7570, JRW, Southern Star, Smith's Red, Kate, Murasaki*
- 8 Purple category cultivars – *WSPF, Molokai Purple, Alley's White, Philipino White, Hawaii Tonga, Hawaii V, Eclipse, Lola Tonga*
- 9 White category cultivars – *Kestle, L135 (Nomad 6, IB098), Meriken, Markham, Snowhite, L49 (Woksaken, IB032), Sumor, Colleambally, L3 (Higaturu, IB269), Whitestar US*

We evaluated the cultivars in the two main sweetpotato cropping regions, with a planting in Bundaberg on 25 January 2011 and another in Cudgen on 22 February 2011. We chose sites with low initial soil nitrogen levels, due to previous negative impacts of nitrogen on Purple and White cultivars. We used growers' fields to replicate commercial production conditions.

We harvested cuttings for each of the cultivars from the Gatton Research Facility sweetpotato planting beds 24 hours before planting. We targeted premium cuttings 30-35 cm long with 3 nodes in the 15 cm of the cutting proximal to the tip. Some cultivars under evaluation, such as *Bienville*, had short internode spaces, with 4-5 nodes in this proximal section.

We prepared cuttings for planting by bunching the required number of cuttings for each plot (20) and tying with string, then wrapping the cut ends to a depth of about 20 cm in damp hessian bags for transport to the experimental sites. We prepared extra cuttings to allow for vine breakages and damage during transport and planting.

We planted cuttings in a random plot, row column design, with replicated check plots of the reference commercial cultivars, in 3 blocks. Each plot consisted of 20 cuttings flat planted at 20 cm (8 inch) spacing as per current grower practice. Weeding hilling, fertiliser and pesticide application were applied by the cooperating grower, using their standard commercial practices.

For assessment at the commercial harvesting stage, we used the following procedure to evaluate yields and quality grades. We dug up the roots from 5 plants per plot. We sorted the roots into the various marketable grades, as well as non-marketable roots. We also noted any quality issues, including cracking, disease, insect or nematode damage.

For classification, we used the following systems (to allow for the propensity for Purple and White categories to produce unevenly shaped roots; we used a grading system that separated marketable roots into a premium and a seconds class).

Table 7 Shape and size grading for classifying sweetpotatoes.

Sweetpotato size grading	Weight	Length	Diameter
Small	200 – 400 g	130-180 mm	50-60 mm
Medium	400 – 800 g	180-240 mm	60-80 mm
Large	>800 g	>230 mm	>80 mm

Table 8 Quality grading for classifying sweetpotatoes.

Marketable roots	
Premium grade	Smooth skin, even elliptic shape, free from damage and defects.
Second grade	Smooth skin, slightly irregular shape or **one** of the following: shallow constriction, bump, bend, small (healed) growth crack or one area of slight damage.

Non marketable roots	
Too small	under 150 g, 120 mm or 40 mm diameter
Defects	Irregular , uneven shape, constrictions, growth cracks, longitudinal grooves, alligator skin, veins
Damaged	Pests, mechanical
Long and thin	Long and thin roots

Bundaberg evaluation

Grower collaborator	Troy Prichard
Location	Rosedale Road, Bundaberg
Planting season	Winter
Planting date	25 January 2011
Commercial harvest	6 September 2011 (231 DAP)

Experimental agronomy summary

The growing period in 2011 tended to be generally cooler and wetter than normal. Frequent heavy rain throughout early 2011 caused severe water logging at this Bundaberg site. We sampled roots initially in May (114 DAP), primarily to collect early root and nodal development information for each cultivar. Data collection at this early stage of development comprised individual root measurements for each node per plant such as length, width, weight, shape, and recording damage due to insects and bacterial/fungal diseases.

By this time most plots had been waterlogged for extended periods, particularly affecting 3 plots of *Darby, Bienville, Evangeline, Northern Star* and *NG 7570*, 2 plots of *Hernandez, Bundy Gold Q953:1, L46, L11, Wanmun, Smith's Red, Kate, Red Red, Murasaki, WSPF, Molokai Purple, Hawaii V and Eclipse*, and one plot each of *Beauregard, Excel, Cudgen Gold, B63, Regal, JRW, Southern Star, Alley's White, Philipino White, Hawaii Tonga* and *Lola Tonga*. This assessment revealed severely inhibited root development in wet plots, with most plants only producing fibrous roots. A decision was then made to conduct only one more harvest at maturity.

For the final harvest, we dug up the roots from 5 plants per plot. We sorted the roots into the various marketable grades, as well as non-marketable roots. We also noted any quality issues, including disease, insect or nematode damage.

Because of the waterlogging, the data was quite variable, making it more difficult to detect performance differences between cultivars.

The following Tables show root numbers and yields for each of the sweetpotato categories, and compare them with the reference industry standard varieties in each category. Unfortunately, storage root production was highly variable in this experiment; probably due to the previously mentioned waterlogging and flooding. This can be seen by the high LSD (p=0.05) values for each of the variables.

Gold category

Because of the previously mentioned high experimental variability, there were no significant differences in the numbers or weights of marketable, non-marketable and total roots produced by all Gold cultivars, compared to *Beauregard* (Table 9).

Table 9 Yield performance of Gold sweetpotatoes in Bundaberg 2011.

Prichard 2011 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Beauregard	4.5	2.6	7.1	46.3	52.0	98.7
B63	6.7	3.3	9.9	53.9	46.7	100.7
Bundy Gold	3.9	2.9	6.8	36.9	62.7	99.3
Bienville	4.4	2.2	6.6	24.9	16.7	41.3
Cudgen Gold	4.1	5.2	9.3	34.3	90.0	124.0
Darby	3.9	1.7	5.6	23.3	16.7	40.0
Evangeline	5.2	0.9	6.1	18.3	5.3	24.0
Excel	4.1	2.4	6.5	24.3	24.0	48.0
Hernandez	5.3	5.0	10.3	40.3	64.7	104.7
Regal	4.2	3.8	8.0	28.5	50.0	78.0
L.s.d	2.9	3.0	4.4	25.9	79.2	100.1

Hernandez and *Cudgen Gold* produced more small marketable roots per plant than *Beauregard*, with a similar result for marketable weights of small roots (Table 10). None of the other cultivars had different size gradings to *Beauregard*, although this lack of difference is almost certainly due to the high experimental variability in this Gold category.

Table 10 Size grades of marketable Gold sweetpotatoes in Bundaberg 2011.

Prichard 2011 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	1.33	0.60	0.67	16.0	17.3	18.8
B63	2.47	0.73	0.07	25.7	18.4	2.4
Bundy Gold	1.53	1.07	0.33	16.9	25.7	20.1
Bienville	2.13	0.07	0.00	15.5	1.1	0.0
Cudgen Gold	3.40*	1.33	0.47	37.7*	27.7	24.3
Darby	1.47	0.20	0.00	12.2	4.5	0.0
Evangeline	0.87	0.00	0.00	5.7	0.0	0.0
Excel	1.87	0.53	0.00	15.3	8.8	0.0
Hernandez	3.93*	0.80	0.27	39.2*	17.5	7.9
Regal	3.00	0.80	0.00	30.1	19.6	0.0
L.s.d	1.74	1.32	0.59	22.5	34.6	29.7

Red category

Similar to the Gold category, there was a high level of variability in performance of Red cultivars within the replicated plots. The Red cultivars *JRW* and *L46* produced more non-marketable roots and total roots per plant than the standard Red cultivar *Northern Star*, whilst L11 had fewer total roots per plant than *Northern Star* (Table 11). *JRW, L46* and *NG7570* all produced a greater weight of non-marketable roots than did *Northern Star*.

Table 11 Yield performance of Red sweetpotatoes in Bundaberg 2011.

Prichard 2011						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
Northern Star	4.5	1.9	6.4	33.7	24.3	58.0
JRW	8.9*	1.4	10.3*	77.2*	12.2	89.5
Kate	3.5	2.9	6.4	31.9	38.1	70.0
L11	1.8	0.6	2.4*	6.1	9.5	15.6
L46	11.3*	0.5	11.8*	79.8*	9.5	89.4
Murasaki	3.6	2.7	6.3	25.1	24.5	49.5
NG7570	6.9	2.3	9.1	80.9*	36.7	117.6
Q953	5.1	3.1	8.2	41.4	32.2	73.6
Red Red	4.4	2.2	6.6	44.0	24.9	68.8
Smith's Red	4.7	2.5	7.3	62.6	35.9	98.5
Southern Star	5.9	3.2	9.1	41.0	36.7	77.7
Wanmun	4.8	1.7	6.4	48.1	20.5	68.7
L.s.d	3.7	2.1	3.9	39.0	35.1	59.6

None of the cultivars had different size gradings to *Northern Star*, although this lack of difference is almost certainly due to the high experimental variability in this Red category (Table 12).

Table 12 Size grades of marketable Red sweetpotatoes in Bundaberg 2011.

Prichard 2011						
Cultivars	**Small marketable root number (per plant)**	**Medium marketable root number (per plant)**	**Large marketable root number (per plant)**	**Small weight (t/ha)**	**Medium weight (t/ha)**	**Large weight (t/ha)**
Northern Star	1.47	0.27	0.13	13.7	5.7	4.9
JRW	1.20	0.20	0.00	9.0	3.2	0.0
Kate	1.40	1.07	0.47	11.7	13.5	12.9
L11	0.27	0.27	0.07	2.0	5.1	2.3
L46	0.53	0.00	0.00	9.5	0.0	0.0
Murasaki	2.33	0.33	0.00	19.5	5.0	0.0
NG7570	1.93	0.33	0.00	26.0	10.8	0.0
Q953	2.27	0.80	0.00	19.7	12.5	0.0
Red Red	1.73	0.33	0.13	14.2	6.1	4.6
Smith's Red	2.20	0.07	0.27	20.9	0.9	14.1
Southern Star	2.33	0.80	0.07	19.9	14.9	2.0
Wanmun	1.13	0.40	0.13	8.9	7.0	4.6
L.s.d	1.49	0.89	0.37	17.7	16.6	15.2

Purple category

As in the previous categories, there was a high level of variability in performance of Purple cultivars within the replicated plots. The Purple cultivar *Hawaii Tonga* produced more marketable roots and total roots per plant than the standard Purple cultivar *WSPF* (Table 13).

Hawaii Tonga also produced a greater yield per hectare of marketable and total roots than did *WSPF.* However, the flesh of *Hawaii Tonga* was a very pale purple colour.

Table 13 Yield performance of Purple sweetpotatoes in Bundaberg 2011.

Prichard 2011						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
WSPF	1.0	1.0	2.0	5.9	17.2	23.1
Alley's White	1.5	0.8	2.3	12.3	15.3	27.6
Eclipse	2.0	1.2	3.2	16.3	16.8	33.0
Hawaii Tonga	2.4	2.5*	4.9*	26.2	37.2*	63.4*
Hawaii V	1.5	0.4	1.9	7.2	5.2	12.3
Lola Tonga	2.5	0.3	2.7	17.1	3.9	20.9
Molokai Purple	1.8	0.7	2.5	14.3	7.1	21.3
Philipino White	1.8	0.3	2.1	9.3	4.7	13.9
L.s.d	2.7	0.8	2.7	23.4	14.8	26.4

The Purple cultivar *Hawaii Tonga* produced more small marketable roots per plant, and a greater weight of small sweetpotatoes per hectare, than did the standard Purple cultivar *WSPF* (Table 14). There were no other differences in size gradings between the other cultivars and *WSPF*.

Table 14 Size grades of marketable Purple sweetpotatoes in Bundaberg 2011.

Prichard 2011						
Cultivars	**Small marketable root number (per plant)**	**Medium marketable root number (per plant)**	**Large marketable root number (per plant)**	**Small weight (t/ha)**	**Medium weight (t/ha)**	**Large weight (t/ha)**
WSPF	0.27	0.67	0.07	2.3	12.7	2.3
Alley's White	0.40	0.27	0.13	4.0	4.7	6.6
Eclipse	0.67	0.47	0.07	6.1	8.5	2.3
Hawaii Tonga	1.67*	0.60	0.27	15.9*	11.7	9.5
Hawaii V	0.27	0.13	0.00	2.7	2.5	0.0
Lola Tonga	0.20	0.07	0.00	2.3	1.5	0.0
Molokai Purple	0.47	0.20	0.00	4.2	2.8	0.0
Philipino White	0.07	0.20	0.00	0.3	4.3	0.0
L.s.d	0.54	0.52	0.25	6.1	9.1	9.2

White category

As in the previous categories, there was a high level of variability in performance of White cultivars within the replicated plots. The White cultivars *Colleambally, L135, L49, Meriken, Markham*, and *Snowhite* produced fewer non-marketable and total roots per plant than the standard White cultivar *Kestle* (Table 13). Cultivar *Whitestar* had fewer non-marketable roots per plant than *Kestle*, while *L49* did not produce any marketable roots.

Cultivars *L135* and *Meriken* had lower marketable sweetpotato yields than *Kestle*, while *L49* had lower marketable and total yields than the industry standard.

Table 15 Yield performance of White sweetpotatoes in Bundaberg 2011.

Prichard 2011						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
Kestle	9.0	3.2	12.2	67.3	64.4	132.0
Colleambally	5.1*	1.6	6.7*	50.1	21.9	72.0
L135	3.6*	1.8	5.3*	60.5	13.5*	74.0
L3	6.3	1.9	8.3	69.7	19.6	89.3
L49	4.2*	0.0*	4.1*	34.0	0.0*	34.0*
Meriken	4.0*	1.6	5.6*	53.8	16.4*	70.0
Markham	4.7*	1.5	6.1*	51.1	25.8	76.7
Snowhite	4.1*	3.0	7.1*	58.1	83.1	141.3
Sumor	7.5	5.3	12.9	59.5	85.2	144.6
Whitestar US	5.9*	3.7	9.6	28.7	41.6	70.0
L.s.d	2.9	2.4	4.2	49.9	47.6	78.7

The White cultivar *Sumor* produced more small marketable roots per plant, than did the standard White cultivar *Kestle* (Table 16).

Cultivar *L49* had a lower yield per hectare of small sweetpotatoes than *Kestle*, while *L135, L49* and *Meriken* had lower yields of medium sweetpotatoes than did *Kestle*. Cultivar *Snowhite* produced a greater weight of large sweetpotatoes than did *Kestle*. There were no other differences in size gradings between the other cultivars and *Kestle*.

Table 16 Size grades of marketable White sweetpotatoes in Bundaberg 2011.

Prichard 2011						
Cultivars	**Small marketable root number (per plant)**	**Medium marketable root number (per plant)**	**Large marketable root number (per plant)**	**Small weight (t/ha)**	**Medium weight (t/ha)**	**Large weight (t/ha)**
Kestle	1.93	0.87	0.40	29.2	24.5	10.7
Colleambally	1.00	0.53	0.07	8.8	10.1	3.0
L135	1.40	0.27	0.00	9.8	3.7*	0.0
L3	1.60	0.27	0.07	12.0	5.0	2.7
L49	0.00	0.00	0.00	0.0*	0.0*	0.0
Meriken	1.27	0.13	0.20	8.2	1.7*	6.5
Markham	1.07	0.33	0.07	15.0	5.5	5.3
Snowhite	1.40	1.00	0.60	22.3	27.8	32.9*
Sumor	4.13*	1.00	0.20	48.0	25.5	5.0
Whitestar US	2.87	0.87	0.00	26.6	15.0	0.0
L.s.d	1.84	0.84	0.38	23.2	20.3	16.3

Cudgen evaluation

Grower collaborator	Paddon family
Location	Reardon's Road Cudgen, NSW
Planting season	Winter
Planting date	22 February 2011
Commercial harvest	11 November 2011 (262 DAP)

Experimental agronomy summary

As in Bundaberg, the growing period in 2011 was generally cooler and wetter than normal.

Due to high level of nematode infestation at this site, we treated one block with Vydate® (240 g/L oxamyl), whilst leaving 2 other blocks untreated to observe susceptibility of different cultivars to soil insect pests.

We sampled roots initially 104 DAP, to collect early root and nodal development information for each cultivar. We observed substantial nematode damage to *Beauregard*, whilst *Bienville* and *Evangeline* appeared much less infected. This difference in nematode infection was less notable at later harvests.

At commercial harvest (262 DAP), both *Evangeline* and *Bienville* exhibited cracking immediately upon harvest. We also noted that *Sumor, Whitestar, Markham, Meriken*, and *L135* were very sappy and produced a larger amount of latex when cut than the existing commercial White cultivar (*Kestle*).

For the final harvest, we dug up the roots from 5 plants per plot. We sorted the roots into the various marketable grades, as well as non-marketable roots. We also noted any quality issues, including disease, insect or nematode damage.

The following Tables show root numbers and yields for each of the sweetpotato categories, and compare them with the reference industry standard varieties in each category.

Although not as bad as Bundaberg, nevertheless the wet conditions at Cudgen in 2011 caused substantial nutrition, nematode and root rot problems with this experiment, creating highly variable storage root production. Thus only major performance differences between the cultivars can be detected statistically.

Gold category

Gold cultivar *Regal* produced fewer non-marketable and total roots per plant, and less total sweetpotato weight per hectare, than *Beauregard* (Table 17).

Bienville had more storage roots per plant, and a greater total yield of sweetpotatoes, than the standard cultivar *Beauregard*.

Table 17 Yield performance of Gold sweetpotatoes in Cudgen 2011.

Paddon 2011						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
Beauregard	3.53	1.27	4.80	20.3	13.3	33.5
B63	3.53	1.60	5.14	22.4	13.7	36.1
Bundy Gold	3.07	2.20	5.26	16.9	20.9	37.8
Bienville	5.07	1.93	7.00*	34.3	17.5	51.8*
Cudgen Gold	3.00	2.00	5.00	25.6	23.9	49.5
Darby	2.27	2.13	4.40	15.5	24.6	40.0
Evangeline	2.87	2.53	5.40	15.8	27.5	43.3
Excel	3.67	0.87	4.54	16.1	7.8	23.9
Hernandez	4.00	2.27	6.26	23.9	21.4	45.3
Regal	1.47*	0.87	2.34*	6.9	6.4	13.3*
L.s.d	1.80	1.43	2.15	14.5	16.3	17.2

Because of the experimental variability, there were no detectable differences in grading distributions between the Gold category cultivars (Table 18). However, we noted both *Bienville* and *Evangeline* produced more premium grade small sweetpotatoes than did *Beauregard* (data not presented).

Table 18 Size grades of marketable Gold sweetpotatoes in Cudgen 2011.

Paddon 2011 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	0.87	0.40	0.00	7.5	5.7	0.0
B63	1.20	0.33	0.07	6.9	5.1	1.7
Bundy Gold	1.47	0.73	0.00	10.3	10.5	0.0
Bienville	1.47	0.47	0.00	11.5	6.1	0.0
Cudgen Gold	1.27	0.60	0.13	10.9	9.5	3.4
Darby	1.20	0.87	0.07	9.1	13.3	2.1
Evangeline	1.67	0.87	0.00	13.7	13.9	0.0
Excel	0.67	0.20	0.00	4.8	3.0	0.0
Hernandez	1.53	0.67	0.07	10.8	8.1	2.5
Regal	0.73	0.13	0.00	4.7	1.7	0.0
L.s.d	1.02	0.79	0.17	8.9	11.8	4.7

Red category

Similar to the Gold category, there was a high level of variability in performance of Red cultivars within the replicated plots. The Red cultivars *JRW, L46, NG7570* and *Q953* produced fewer marketable roots per plant than the standard Red cultivar *Northern Star*.

Northern Star had the greatest total weight of Red sweetpotatoes in this experiment, with all except *JRW* having significantly lower total weights per hectare. There were no significant differences in non-marketable yields between the Red cultivars; however, all except *Southern Star* had much lower marketable yields than *Northern Star* (Table 19).

Table 19 Yield performance of Red sweetpotatoes in Cudgen 2011.

Paddon 2011 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Northern Star	3.7	2.0	5.7	36.1	27.9	64.1
JRW	4.6	0.0*	4.6	44.3	0.0*	44.3
Kate	2.7	1.1	3.7	21.1	10.9*	32.0*
L11	2.3	1.1	3.4	20.8	16.3	37.1*
L46	3.5	0.1*	3.7	35.8	1.7*	37.6*
Murasaki	3.7	1.5	5.3	17.5	14.5*	31.9*
NG7570	3.9	0.9*	4.8	31.8	9.3*	41.2*
Q953	4.1	0.3*	4.4	32.5	2.3*	34.9*
Red Red	2.5	1.1	3.5	18.7	11.7*	30.5*
Smith's Red	3.1	1.1	4.3	16.1	10.2*	26.3*
Southern Star	2.9	1.2	4.1	23.4	16.4	39.8*
Wanmun	4.3	0.6*	4.9	31.0	5.3*	36.3*
L.s.d	2.0	0.9	2.1	19.9	12.4	22.7

Red cultivars *JRW, L46* and *Q953* produced a significantly lower number of small sized roots per plant than *Northern Star*, whilst only *Kate, L11, Murasaki*, and *Southern Star* produced the same number of marketable medium roots per plant as the industry standard. Only *Northern Star* and *Southern Star* produced any large marketable roots (Table 20).

The cultivars *JRW* and *L46* had a less weight/ha of small sweetpotatoes than *Northern Star*, while only *Kate, L11, Murasaki*, and *Southern Star* produced the same weight/ha of marketable medium roots as that industry standard. *Northern Star* and *Southern Star* produced the same amount of large roots.

Table 20 Size grades of marketable Red sweetpotatoes in Cudgen 2011.

Paddon 2011						
Cultivars	**Small marketable root number (per plant)**	**Medium marketable root number (per plant)**	**Large marketable root number (per plant)**	**Small weight (t/ha)**	**Medium weight (t/ha)**	**Large weight (t/ha)**
Northern Star	0.93	0.93	0.13	7.4	31.1	4.4
JRW	0.00*	0.00*	0.00*	0.0*	0.0*	0.0*
Kate	0.60	0.47	0.00*	4.1	15.5	0.0*
L11	0.60	0.47	0.00*	6.0	15.5	0.0*
L46	0.07*	0.07*	0.00*	0.7*	2.2*	0.0*
Murasaki	1.13	0.40	0.00*	8.7	13.3	0.0*
NG7570	0.67	0.27*	0.00*	5.1	8.9*	0.0*
Q953	0.27*	0.00*	0.00*	2.3	0.0*	0.0*
Red Red	0.73	0.33*	0.00*	6.9	11.1*	0.0*
Smith's Red	0.87	0.27*	0.00*	6.6	8.9*	0.0*
Southern Star	0.60	0.47	0.13	5.0	15.5	4.4
Wanmun	0.47	0.13*	0.00*	3.6	4.5*	0.0*
L.s.d	0.66	0.58	0.08	5.2	19.4	2.6

Purple category

The Purple cultivars *Alley's White* and *Lola Tonga* set fewer non-marketable storage roots per plant than the standard Purple cultivar *WSPF* (Table 21). *Alley's White, Lola Tonga, Molokai Purple* and *Philipino White* also set a fewer total roots per plant than *WSPF*.

Alley's White also had a lower weight of non-marketable sweetpotatoes than *WSPF*, whilst both *Alley's White* and *Lola Tonga* had lower overall total sweetpotato weights than the industry standard.

Table 21 Yield performance of Purple sweetpotatoes in Cudgen 2011.

Paddon 2011						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
WSPF	3.4	0.87	4.3	30.4	10.6	41.0
Alley's White	1.9*	0.20	2.1*	13.7*	0.6	14.4*
Eclipse	3.4	0.87	4.3	19.6	8.3	27.9
Hawaii Tonga	3.7	0.53	4.2	29.3	5.7	35.1
Hawaii V	3.9	0.47	4.3	29.1	4.1	33.2
Lola Tonga	1.3*	0.33	1.7*	19.4	3.2	22.6*
Molokai Purple	2.1	0.73	2.9*	19.3	7.4	26.7
Philipino White	2.3	0.60	2.9*	21.9	11.3	33.2
L.s.d	1.3	0.90	1.1	15.8	11.3	15.2

In this Purple category, there were no differences in gradings of marketable roots between the industry standard *WSPF* and the other cultivars (Table 22).

Table 22 Size grades of marketable Purple sweetpotatoes in Cudgen 2011.

Paddon 2011 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
WSPF	0.47	0.40	0.00	3.5	7.1	0.0
Alley's White	0.13	0.07	0.00	0.6	0.0	0.0
Eclipse	0.53	0.33	0.00	3.7	4.6	0.0
Hawaii Tonga	0.33	0.20	0.00	2.6	3.1	0.0
Hawaii V	0.40	0.07	0.00	3.2	0.8	0.0
Lola Tonga	0.27	0.07	0.00	2.5	0.6	0.0
Molokai Purple	0.33	0.40	0.00	2.4	5.0	0.0
Philipino White	0.33	0.27	0.00	7.3	3.9	0.0
L.s.d	0.52	0.53	0.00	7.4	8.0	0.0

White category

There were high proportions of non-marketable roots due to the wet season, rots, nematode infection and the general tendency of some white cultivars to become bumpy, twisted, misshapen, and crack.

L135, L3, Meriken and *Snowhite* produced more non-marketable roots per plant than the industry standard *Kestle* (Table 23). Similarly, *L3, Meriken* and *Snowhite* produced fewer marketable roots per plant than *Kestle*. Overall, *Snowhite* produced more total storage roots per plant than *Kestle*.

L3, Markham and *Snowhite* produced a greater weight of non-marketable sweetpotatoes than *Kestle*, whilst *Sumor* and *Whitestar* produced less non-marketable sweetpotatoes than that industry standard.

L3 and *Snowhite* had less weight of marketable sweetpotatoes per hectare than *Kestle*, while *Markham* and *Snowhite* had the greatest sweetpotato weight per hectare; significantly more than *Kestle*.

Table 23 Yield performance of White sweetpotatoes in Cudgen 2011.

Prichard 2011						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
Kestle	3.1	1.00	4.1	32.8	10.9	43.7
Colleambally	4.1	0.73	4.8	46.8	11.8	58.6
L135	4.4*	0.30	5.0	35.9	3.6	39.5
L3	4.5*	0.07*	4.6	50.0*	0.5*	50.5
L49	3.7	0.40	4.1	28.9	3.7	32.5
Meriken	4.4*	0.13*	4.5	35.4	1.0	36.4
Markham	3.3	0.40	3.7	59.3*	6.7	66.0*
Snowhite	5.9*	0.07*	6.0*	67.7*	0.3*	68.1*
Sumor	2.8	1.27*	4.1	10.6*	14.4	25.0
Whitestar US	2.6	1.27	3.9	15.9*	9.3	25.3
L.s.d	1.3	0.80	1.8	15.9	10.0	19.9

Of these White cultivars, *L3, L49, Meriken* and *Snowhite* only produced small roots in the marketable grades, and did not produce any medium size roots (Table 24).

Table 24 Size grades of marketable White sweetpotatoes in Cudgen 2011.

Prichard 2011						
Cultivars	**Small marketable root number (per plant)**	**Medium marketable root number (per plant)**	**Large marketable root number (per plant)**	**Small weight (t/ha)**	**Medium weight (t/ha)**	**Large weight (t/ha)**
Kestle	0.47	0.53	0.00	3.4	7.5	0.0
Colleambally	0.13	0.53	0.07	1.2	8.9	1.7
L135	0.13	0.20	0.00	0.4	3.1	0.0
L3	0.07	0.00	0.00	0.5	0.0	0.0
L49	0.40	0.00	0.00	3.7	0.0	0.0
Meriken	0.13	0.00	0.00	1.0	0.0	0.0
Markham	0.20	0.13	0.07	1.8	3.1	1.8
Snowhite	0.07	0.00	0.00	0.4	0.0	0.0
Sumor	0.60	0.67	0.00	4.4	10.0	0.0
Whitestar US	0.80	0.47	0.00	4.8	4.5	0.0
L.s.d	0.54	0.51	0.09	4.5	7.7	2.4

Cultivar review and consolidation in 2011

On 16 November 2011, the project team held a large industry field day (Fig. 5) at the Cudgen cultivar evaluation site, followed by a project meeting to review progress and plan future efforts. Over 30 stakeholders attended, including growers from Cudgen and Bundaberg, ASPG technical and advisory team, along with wholesalers and agribusiness personnel. Attendees viewed all 40 sweetpotato cultivars as they were harvested during the field walk. We presented data on growth and yield performance of the cultivars, as well as observations on quality aspects, including pest and disease tolerance, shape and size gradings, as well as skin/flesh textures and colours (Fig. 6 and Fig. 7).

Figure 5 **Sweetpotato industry stakeholders at industry field day, November 2011**

Nematode damage in *Beauregard*

Wireworm damage in *Beauregard*

Split skin in *Evangeline*

Scurf in *Cudgen Gold*

Figure 6 **Quality issues in Gold category sweetpotatoes, November 2011.**

Large growth cracks in *Meriken*

Large, irregular shape in *Markham*

Low yields and fibrous roots in *L49*

Low yields in *JRW*

Figure 7 Quality issues in other category sweetpotatoes, November 2011.

Eating quality evaluation

After the field day, the project team cooked and presented 21 of the better performing cultivars for taste testing to growers, their families and industry stakeholders (Fig. 8). We asked their opinions on which cultivars they favoured the most in terms of cooked appearance (Fig. 9) and eating quality. Of the people who voted, 6 voted for *Murasaki*, 5 for *Snowhite* and *Regal*, 3 for *Sumor* and *Northern Star*, and 1 vote each for *WSPF, Eclipse, Evangeline, Southern Star, Molokai Purple,* and *Kate*. The cultivars *B63, Kestle, L3, Philipino white, Excel, Smith's Red, Beauregard, Bienville,* and *Whitestar USA* did not receive any votes as best eating.

Figure 8 **Industry sweetpotato taste evaluation in Cudgen, November 2011.**

Figure 9 **Uncooked appearance of Gold, Red, Purple and White category sweetpotatoes at Cudgen cultivar assessment, November 2011.**

Cultivar consolidation

At the industry/project meeting after the Cudgen field day, the project team ASPG Technical Group, and allied industry stakeholders reviewed the field performance and sweetpotato quality assessments undertaken in 2011. There was also substantial consideration given to grower comments and perspectives on cultivars, as they are the people who make the ultimate decision about what materials they will purchase and use.

The following cultivars were eliminated from the ongoing evaluation process:

Gold category

Hernandez and *Darby*, as they had already been extensively evaluated before the advent of *Beauregard*; growers were unlikely to go back to these superseded cultivars.

In general experience, and in the two evaluation experiments, *Cudgen Gold* and *Bundy Gold* have proven only slight variants to *Beauregard*. Hence, they have similar performance and product quality, and are susceptible to the same pests and diseases as the industry standard. Thus, there are no advantages to their use.

Excel had a pale skin and flesh colour that would not be acceptable in markets, as it does not look as good as *Beauregard*. It was also sappy when cut. Its performance was not different to *Beauregard* in the evaluations.

Red category

JRW, NG 7570, Q953, Wanmun, L46 all had lower yields than *Northern Star*, but more importantly, also had irregular shape and sunken lenticels, which reduces their market desirability.

Red Red, *Smiths Red* and *L11* did not demonstrate any superior performance capacity or quality advantages compared to *Northern Star*.

Purple category

Hawaii V, Alleys White, and *Hawaii Tonga* demonstrated similar or lower yield performance, commonly with irregular shape as well. They had pleasing white skin colour, comparable to the industry standard *WSPF*, however their flesh was often very pale purple to almost entirely white.

Lola Tonga produced large, irregular roots with pale pink flesh and pale pink/ cream translucent skin.

White category

Colleambally used to be the industry standard, and was replaced by *Kestle*. Growers were unlikely to go back to this superseded cultivar.

Snowhite had large, irregular roots, with large longitudinal grooves, which suggests it would be hard to market.

L135, Markham and *Meriken* also had large, irregular roots, with substantial growth cracks, and low marketable yields.

Thus, the group determined to proceed with the following 16 cultivars for ongoing evaluation. There was particular interest in the alternative flesh colour (Purple) cultivars, and Gold cultivars that had resistance to soil pests and diseases.

Gold category – *Beauregard* (industry standard), *Evangeline, Bienville, B63, Regal*

Red category – *Northern Star* (industry standard), *Murasaki, Kate, Southern Star*

Purple category – *WSPF* (industry standard), *Molokai Purple, Philipino White, Eclipse*

White category – *Kestle* (industry standard), *Whitestar, Sumor*

Bulked planting material for second stage evaluations

We bulked up Pathogen-Tested tissue culture plantlets of 49 cultivars held in the germplasm bank in vitro in May 2010. After approximately 3 months growth, we de-flasked these plants into individual planting tubs in an insect screened (quarantine meshed) tunnel house at Gatton Research Facility in August 2010 to produce cuttings. After the decision in November 2010 to exclude the initial 9 cultivars from the first stage screening evaluations, the number of plantings in the tunnel house was reduced to the 40 cultivars evaluated in 2011. Recall that bulking the planting materials have to commence preparation the year before the screening experiments are due.

Standardised cuttings were removed from these PT tested plants in the tunnel house in February 2011 and planted into individual plots. As in Bowen the previous year, each Gatton plot was approximately 3 m long (depending on the number of initial cuttings available) and 1 row wide, with an inter-row spacing of 1.5 m. We planted cuttings 30 cm apart, and grew them using standard grower agronomy (irrigation, nutrition, pest management). We observed cultivar characteristics, including vine growth rates, vigour, habits and susceptibility to insect pests and bacterial and fungal diseases over the life of the crop. We documented them, to provide detailed germplasm accession data for future use.

We harvested roots from this bulking experiment in September 2011. We again collected basic data on cultivar characteristics, such as the number of roots produced, the shape of the roots and the skin and flesh colour and dry matter content.

Plantbed supply of cuttings for second stage evaluations

We took the harvested roots from the bulking experiment and planted them into 40 individual seedbeds at Gatton Research Facility in September 2011, to produce the vegetative planting material for the second stage evaluations. Note that at this stage, the first stage evaluations were still underway, so no assumptions could be made as to what cultivars would be tested in the following year.

We observed vine growth for vigour, habit and susceptibility to insect pests, bacterial and fungal diseases over the life of the plant beds.

Second stage cultivar evaluation experiments in 2011-12

In these experiments, we evaluated the 16 cultivars in the 4 distinct skin/flesh combinations:

- 5 Gold category cultivars – *Beauregard, Bienville, Evangeline, B63, Regal;*
- 4 Red category cultivars – *Northern Star, Southern Star, Kate, Murasaki;*
- 4 Purple category cultivars – *WSPF, Molokai Purple, Philipino White, Eclipse*
- 3 White category cultivars – *Kestle, Sumor, Whitestar US*

We evaluated the cultivars in the two main sweetpotato cropping regions, with plantings in Bundaberg in November 2011 and February 2012, and another in Cudgen in December 2011. We used growers' fields to replicate commercial production conditions.

We harvested cuttings for each of the cultivars from the Gatton Research Facility sweetpotato planting beds 24 hours before planting. We targeted premium cuttings 30-35 cm long with 3 nodes in the 15 cm of the cutting proximal to the tip. Some cultivars under evaluation had short internode spaces, with 4-5 nodes in this proximal section.

We prepared cuttings for planting by bunching the required number of cuttings for each plot (20) and tying with string, then wrapping the cut ends to a depth of about 20 cm in damp hessian bags for transport to the experimental sites. We prepared extra cuttings to allow for vine breakages and damage during transport and planting.

We planted cuttings in a random plot, row column design, with replicated check plots of the reference commercial cultivars, in 3 blocks. We split the plots into 2 nitrogen rates, to explore the impacts of different nitrogen fertiliser levels on cultivar performance. Each plot consisted of 20 cuttings flat planted at 20 cm (8 inch) spacing as per current grower practice. Weeding hilling, fertiliser and pesticide application were applied by the cooperating grower, using their standard commercial practices.

For assessment at the commercial harvesting stage, we used the following procedure to evaluate yields and quality grades. We dug up the roots from 5 plants per plot. We sorted the roots into the various marketable grades, as well as non-marketable roots. We also noted any quality issues, including cracking, disease, insect or nematode damage. We classified and graded the sweetpotato roots according to the methodology described for the first stage evaluations.

Bundaberg evaluation 2

Grower collaborator Duane Joyce

Location Moore Park Road, Bundaberg

Planting season Summer

Planting date 19 November 2011

Nitrogen rates Low 63 units/ha, High 109 units/ha

Commercial harvest 24 April 2012 (149 DAP)

Experimental agronomy notes

Although this was a low inherent nitrogen fertility site (pre-plant soil test 3 ppm nitrate), there were no obvious effects of nitrogen rate on cultivar performance. Hence, we have only reported the cultivar effects here.

The following Tables show root numbers and yields for each of the sweetpotato categories, and compare them with the reference industry standard cultivars in each category.

Gold category

At this site, severe nematode damage in *Beauregard* led to rots in roots and reduced yield. There was no splitting observed in *Bienville* at assessment, however we observed splitting in roots left out in the field overnight. *Bienville* and *Evangeline* produced more marketable roots per plant than *Beauregard*, whilst *Regal* produced fewer marketable roots per plant than that industry standard (Table 25). *Bienville* also produced more total roots per plant than *Beauregard*.

Regal had significantly lower weights of marketable roots and total roots per hectare than *Beauregard*.

Table 25 Yield performance of Gold sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12						
Cultivars	**Non Marketable root number (per plant)**	**Marketable root number (per plant)**	**Total root number (per plant)**	**Non Marketable weight (t/ha)**	**Marketable weight (t/ha)**	**Total weight (t/ha)**
Beauregard	3.6	1.6	5.2	43.9	30.7	74.6
B63	3.8	1.6	5.4	42.8	27.5	70.3
Bienville	4.3	2.5*	6.8*	31.1	33.5	64.6
Evangeline	3.2	2.6*	5.8	26.9	44.3	71.3
Regal	4.5	0.6*	5.0	25.2	6.7*	31.9*
L.s.d	1.2	0.6	1.1	17.1	13.9	15.6

Bienville produced more small marketable roots per plant and a greater weight per hectare of small marketable roots than *Beauregard* (Table 26). Similarly, *Evangeline* produced more medium marketable roots per plant and a greater weight per hectare of medium marketable roots than *Beauregard*.

Conversely, *Regal* had fewer medium marketable roots per plant and a lesser weight per hectare of medium marketable roots than *Beauregard*.

Table 26 Size grades of marketable Gold sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	0.53	0.77	0.33	5.7	14.1	10.8
B63	0.60	0.63	0.33	5.5	11.3	10.8
Bienville	1.43*	0.90	0.13	14.5*	15.2	3.8
Evangeline	0.73	1.53*	0.33	6.7	28.1*	9.5
Regal	0.37	0.20*	0.00	4.0	2.7*	0.0
L.s.d	0.51	0.41	1.20	5.1	7.8	9.8

Red category

At this site, we observed shallow growth cracks in the industry standard, *Northern Star*.

Murasaki produced more non-marketable roots per plant than *Northern Star* (Table 27); however, there were no other differences in yield performance between the cultivars.

Table 27 Yield performance of Red sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Northern Star	2.57	0.87	3.43	41.2	13.1	54.3
Murasaki	4.30*	1.20	5.50	34.5	15.0	49.5
Kate	2.53	0.80	3.33	35.1	17.8	53.0
Southern Star	2.20	1.10	3.30	24.5	21.3	45.7
L.s.d	1.56	0.70	2.08	16.2	8.6	16.7

Kate and *Southern Star* produced more large marketable roots per plant and a greater weight per hectare of large marketable roots than the industry standard *Northern Star* (Table 28).

Table 28 Size grades of marketable Red sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12						
Cultivars	**Small marketable root number (per plant)**	**Medium marketable root number (per plant)**	**Large marketable root number (per plant)**	**Small weight (t/ha)**	**Medium weight (t/ha)**	**Large weight (t/ha)**
Northern Star	0.33	0.47	0.07	11.1	7.7	2.4
Murasaki	0.67	0.50	0.03	22.2	6.9	1.1
Kate	0.17	0.37	0.27*	5.5	6.5	9.9*
Southern Star	0.40	0.37	0.33*	13.3	7.1	10.7*
L.s.d	0.46	0.45	0.02	8.3	6.2	7.2

Purple category

The yield performances of all Purple cultivars at this site were similar, with no statistically detectable differences in sweetpotato marketable proportions or size gradings (Table 29, Table 30).

Table 29 Yield performance of Purple sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
WSPF	1.73	0.30	2.03	30.9	6.3	37.2
Alley's White	1.50	0.27	1.77	24.1	3.1	27.1
Eclipse	1.67	0.70	2.37	34.6	13.9	48.5
Molokai Purple	1.90	0.33	2.23	22.6	6.1	28.7
Philipino White	2.23	0.60	2.83	31.1	8.2	39.3
L.s.d	1.16	0.62	1.49	17.6	9.5	21.3

Table 30 Size grades of marketable Purple sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
WSPF	0.07	0.20	0.03	0.9	4.3	1.1
Alley's White	0.17	0.10	0.00	1.4	1.7	0.0
Eclipse	0.17	0.47	0.07	2.0	9.3	2.6
Molokai Purple	0.13	0.17	0.03	1.1	3.4	1.6
Philipino White	0.27	0.30	0.03	2.8	4.3	1.2
L.s.d	0.36	0.39	0.06	3.4	7.0	2.8

White category

The cultivar *Sumor* produced more unmarketable roots, fewer marketable roots per plant, and a much lower weight of marketable sweetpotatoes per hectare, than *Kestle* (Table 31). *Whitestar* had more marketable and total roots per plant than the industry standard.

Table 31 Yield performance of White sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Kestle	2.57	0.57	3.13	52.06	11.60	40.46
Sumor	4.10*	0.23*	4.33	43.06	3.27*	39.73
Whitestar US	3.87	0.93*	4.80*	55.66	14.87	40.86
L.s.d	1.38	0.20	1.26	8.16	3.42	9.61

Sumor produced a lower weight per hectare of medium grade roots than the industry standard *Kestle* (Table 32).

Table 32 Size grades of marketable White sweetpotatoes in Bundaberg 2011/12.

Joyce 2011/12 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Kestle	0.13	0.30	0.13	1.7	5.7	4.2
Sumor	0.13	0.07	0.03	1.3	1.1*	1.0
Whitestar US	0.33	0.57	0.03	3.7	10.2	0.9
L.s.d	0.09	0.33	0.13	3.1	4.6	2.9

Cudgen evaluation 2

Grower collaborator	Stu and Kev Kennedy
Location	Reardon's Road, Cudgen
Planting season	Summer/Autumn
Planting date	20 December 2011
Nitrogen rates	Low 56 units/ha, High 104 units/ha
Commercial harvest	17 July 2012 (216 DAP)

Experimental agronomy notes

Although this was a low inherent nitrogen fertility site (pre-plant soil test 6 ppm nitrate), there were no obvious effects of nitrogen rate on cultivar performance. Hence, we have only reported the cultivar effects here. The exception was the observation that with the Gold cultivar *Bienville*, 20% of the roots split at commercial harvest in the high nitrogen plots, whilst only 4% split in the low nitrogen plots.

The following Tables show root numbers and yields for each of the sweetpotato categories, and compare them with the reference industry standard cultivars in each category.

Gold category

At this site, both *Beauregard* and *B63* showed substantial levels of nematode damage.

Industry observations were that *Beauregard* gave a reliable, consistently good yield, but there were concerns about nematode damage, scab (scurf) and rots. *B63* seemed very similar to *Beauregard*, with the same positive and negative attributes. With *Bienville*, they liked the size, shape and skin colour; felt it was very sweet to eat, with good nematode resistance and skin toughness. However, growers expressed concerned about splitting and rots.

Regal produced more unmarketable roots per plant than *Beauregard* (Table 33). All 4 new cultivars had fewer marketable roots per plant than *Beauregard*. Cultivar *B63* had less weight/hectare of non-marketable sweetpotatoes than *Beauregard* did, whilst *Bienville*, *Evangeline* and *Regal* all had less marketable sweetpotatoes per hectare than the industry standard. All 4 new cultivars produced a lower total weight of sweetpotatoes than *Beauregard*.

Table 33 Yield performance of Gold sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Beauregard	5.6	5.1	10.1	29.9	76.3	106.3
B63	3.7	3.8*	7.5	15.9*	64.6	80.5*
Bienville	7.5	4.0*	11.5	24.1	53.3*	77.4*
Evangeline	5.4	2.9*	8.3	24.5	38.5*	63.1*
Regal	10.7*	1.5*	12.3	25.3	14.6*	39.9*
L.s.d	4.2	1.0	4.6	11.7	14.9	19.9

B63 and *Evangeline* produced fewer small marketable roots per plant than *Beauregard* did, while *Bienville*, *Evangeline* and *Regal* all produced fewer medium marketable roots per plant than the industry standard (Table 34). *B63*, *Evangeline* and *Regal* had less weight/hectare of small marketable roots than *Beauregard*. Cultivar *Bienville* produced less medium marketable root weight per hectare than *Beauregard*. Both *Evangeline* and *Regal* had less small, medium and large weights of marketable roots than the industry standard *Beauregard*.

Table 34 Size grades of marketable Gold sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	1.20	0.70	1.73	22.5	31.2	22.7
B63	0.53*	0.50	1.77	13.2*	33.7	17.7
Bienville	1.20	0.43*	1.20	18.4	20.9*	14.0
Evangeline	0.63*	0.27*	1.00	13.2*	18.1*	7.3*
Regal	0.80	0.00*	0.20	10.9*	3.7*	0.0*
L.s.d	0.52	0.44	0.47	6.4	8.7	13.9

Red category

At this site, we observed severe growth cracks in the industry standard, *Northern Star*. Growers disliked the shape, splits and cracks, and felt this cultivar could really only be successfully grown in red soil at certain times of the year. With *Murasaki*, they appreciated its yields and tough, attractive skin; however, they were less impressed with its 'ball' shape. Growers appreciated the shape and consistent, well coloured, smooth skins of *Kate* and *Southern Star*. The impression was that these latter cultivars may need to be harvested earlier than the industry standard, as they tended to grow too long. Anecdotally, *Kate* was said to be attractive to rats.

Southern Star produced fewer non-marketable roots per plant, than did *Northern Star* (Table 35). Both *Murasaki* and *Southern Star* had less non-marketable weight sweetpotatoes per hectare than *Northern Star*, while *Southern Star* also produced a greater weight of marketable sweetpotatoes per hectare, compared to *Northern Star*. Interestingly, although *Murasaki* produced more marketable roots per plant than *Northern Star*, it produced a similar weight of marketable roots per hectare, and less total weight of sweetpotatoes per hectare, compared to *Northern Star*.

Table 35 Yield performance of Red sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Northern Star	5.14	1.50	6.64	48.4	22.5	70.9
Murasaki	5.30	2.60*	7.90	18.1*	26.9	45.0*
Kate	5.86	1.10	6.96	40.4	21.7	62.1
Southern Star	3.44*	2.13	5.56	28.7*	42.6*	71.3
L.s.d	1.16	0.80	1.52	15.3	11.1	10.6

Murasaki had more small marketable roots per plant, and a greater weight of small marketable roots per hectare than the industry standard *Northern Star* (Table 36). *Kate* had fewer small marketable roots per plant than *Northern Star*. There were no other statistical differences between the new cultivars and the industry standard.

Table 36 Size grades of marketable Red sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Northern Star	0.90	0.33	0.27	7.95	6.20	8.40
Murasaki	2.00*	0.57	0.03	16.72*	9.27	0.93
Kate	0.37*	0.53	0.20	3.39	10.20	8.13
Southern Star	0.63	0.90	0.60	5.10	16.47	21.00
L.s.d	0.53	0.64	0.41	5.68	12.25	13.48

Purple category

Growers expressed concern at the shape of *WSPF* in this experiment. They approved the shape and flesh colour of *Eclipse*, with a minor concern that a few roots were excessively sized. They liked the shape, skin and yield of *Philipino White*, however thought the flesh colour could be improved by being darker and more consistent.

There were no differences between the new cultivars and the industry standard *WSPF* in terms of storage roots per plant. However, *Molokai Purple* had lower marketable and total weights of sweetpotato per hectare than *WSPF* (Table 37).

Table 37 Yield performance of Purple sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
WSPF	5.5	3.2	8.7	22.7	36.4	59.1
Eclipse	4.2	1.6	5.8	24.3	22.0	46.3
Molokai Purple	6.2	0.9	7.1	23.4	10.3*	33.7*
Philipino White	3.4	2.7	6.1	23.1	39.2	62.3
L.s.d	2.1	1.7	2.9	16.3	14.9	17.0

Molokai Purple also had fewer medium marketable sweetpotatoes per plant, and less medium marketable sweetpotatoes in t/ha, compared to the industry standard *WSPF* (Table 38).

Table 38 Size grades of marketable Purple sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
WSPF	1.47	1.00	0.77	12.47	18.40	5.53
Eclipse	0.97	0.60	0.07	9.20	10.73	2.13
Molokai Purple	0.57	0.33*	0.00	5.00	5.27*	0.00
Philipino White	1.27	1.13	0.27	11.27	19.66	8.20
L.s.d	1.16	0.49	1.16	10.33	9.73	8.25

White category

In inspecting the White cultivars, growers liked the size and shape of *Kestle*. In contrast, they were not approving of the black pitting and eyes on the skin of *Whitestar*, and felt they would not look good packed in a carton. They appreciated the shape and flesh colour of *Sumor*, however disliked its sappy exudate when cut, and how readily the skin marked.

The cultivar *Sumor* produced fewer marketable roots per plant, and a much lower weight of marketable and total sweetpotatoes per hectare, than *Kestle* (Table 39).

Table 39 Yield performance of White sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Kestle	4.40	2.47	6.86	20.73	40.86	61.59
Sumor	6.04	1.77*	7.80	26.53	17.80*	44.33*
Whitestar US	4.66	2.57	7.24	21.60	38.46	60.06
L.s.d	3.15	0.50	3.19	11.01	9.26	11.58

Sumor had fewer large, marketable roots per plant than *Kestle*, and produced a lesser weight of large, marketable roots than that industry standard cultivar (Table 49).

Table 40 Size grades of marketable White sweetpotatoes in Cudgen 2011/12.

Kennedy 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Kestle	1.22	0.88	0.37	10.80	16.93	13.13
Sumor	1.23	0.50	0.03*	9.00	7.87	0.93*
Whitestar US	1.27	1.10	0.20	11.47	20.26	6.73
L.s.d	0.41	0.87	0.29	3.94	13.13	10.59

Bundaberg evaluation 3

Grower collaborator	Dave Holt
Location	Rubyanna Road, Bundaberg
Planting season	Winter
Planting date	9 February 2012
Nitrogen rates	Low 44 units/ha, High 88 units/ha
Commercial harvest	4 September 2012 (210 DAP)

Experimental agronomy notes

This was a moderate nitrogen fertility site (pre-plant soil test 20 ppm nitrate), perfect for sweetpotato growing. There were no obvious effects of nitrogen rate on cultivar performance. Hence, we have only reported the cultivar effects here. Note there were only minor levels of splitting of the Gold cultivar *Bienville* at this site; less than 1% of the roots harvested.

The following Tables show root numbers and yields for each of the sweetpotato categories, and compare them with the reference industry standard cultivars in each category.

Gold category

Industry observations at this site were that *Beauregard* gave reliable consistently good yield, with good shape and colour. *B63* also appeared to perform strongly, with good yields and sweetpotato quality. With *Bienville*, they liked the size, shape, skin and flesh colour, and felt it produced high root numbers. Even though the proportion of splitting was very low, it was still a concern for the growers. They observed that while *Regal* produced good root numbers, they felt the sweetpotatoes were too long, and did not 'size' effectively. They also felt the skin was too purple/red, and may be confused in the market place with Red categories.

Bienville, *Evangeline* and *Regal* produced more non-marketable roots per plant than *Beauregard* did, while *Regal* produced fewer marketable roots per plant than the industry standard (Table 41). Both *Bienville* and *Regal* had more total roots per plant, and a greater weight of non-marketable sweetpotatoes per hectare. All the new cultivars produced a lesser weight of marketable sweetpotatoes per hectare than *Beauregard* did, whilst *Regal* had the lowest total weight of sweetpotatoes overall.

Table 41 Yield performance of Gold sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Beauregard	3.0	3.0	6.1	17.8	57.3	75.2
B63	3.5	2.2	5.7	21.8	42.9*	64.7
Bienville	7.7*	2.1	9.8*	28.1*	32.4*	60.5
Evangeline	5.3*	2.2	7.5	20.8	36.7*	57.5
Regal	8.6*	1.2*	9.8*	27.4*	17.5*	44.9*
L.s.d	1.7	1.0	1.8	6.1	14.4	17.9

Cultivars *Bienville* and *Regal* produced less weight of large sweetpotatoes per hectare than did the industry standard, *Beauregard*.

Table 42 Size grades of marketable Gold sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	0.67	0.57	1.33	11.7	24.2	21.5
B63	0.20	0.53	1.13	4.1	20.1	18.7
Bienville	0.67	0.10	0.93	10.5	18.3	3.5*
Evangeline	0.60	0.27	1.03	9.1	18.7	8.9
Regal	0.43	0.00	0.77	7.8	9.8	0.0*
L.s.d	0.21	0.36	0.58	10.9	10.8	13.3

Red category

At this site, we again observed severe growth cracks in the industry standard, *Northern Star*. Growers approved of the strong skin, but disliked the shape, splits and cracks. With *Murasaki*, they appreciated its even set and deep coloured attractive skin. They did not approve its small size and shape, and felt the creamy flesh colour was not as appealing as the white flesh of *Northern Star*. Growers liked the shape, skin and white flesh of *Kate* and *Southern Star*; however, they felt the sweetpotatoes were too long. In this evaluation, they liked the smooth skin and size, and the lack of cracking compared to *Northern Star*. They felt the yield difference between plants was too variable to be confident in their performance.

Murasaki produced more marketable roots per plant, and had less weight per hectare of non-marketable roots than did *Northern Star* (Table 43). *Southern Star* performed well in this evaluation. Even though *Southern Star* and *Northern Star* had similar total weights of sweetpotatoes per hectare, *Southern Star* had less non-marketable weight, and greater marketable weight.

Table 43 Yield performance of Red sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Northern Star	6.1	1.0	7.1	48.7	11.5	60.1
Murasaki	5.3	2.3*	7.6	18.6*	30.7	49.3
Kate	5.3	1.0	6.3	34.7	19.9	54.5
Southern Star	4.4	2.0	6.4	25.3*	46.3*	71.6
L.s.d	2.7	1.0	2.7	14.5	20.6	18.4

Murasaki had more small marketable roots per plant, and a greater weight of small marketable roots per hectare than the industry standard *Northern Star* (Table 44). *Southern Star* had more large marketable roots per plant, and a greater weight of large marketable roots per hectare than did *Northern Star*.

Table 44 Size grades of marketable Red sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Northern Star	0.67	0.37	0.00	5.5	5.9	0.0
Murasaki	1.50*	0.80	0.03	14.7*	15.0	1.0
Kate	0.27	0.50	0.27	2.1	8.3	9.4
Southern Star	0.60	0.70	0.70*	4.9	13.6	27.8*
L.s.d	0.82	0.62	0.33	7.5	10.1	18.3

Purple category

Growers noted that the flesh colour of the Purple cultivars were paler than in other evaluations. *WSPF* and *Eclipse* also had rare instances of growth cracks, which we had not seen at other sites. Growers felt that *WSPF* had low numbers of root set, were smaller in size and had pale flesh colour compared to the new cultivars. They expressed concerns that they were not a readily saleable product. Whilst *Molokai Purple* had good flesh colour, they were concerned that its shape would mean low marketable yield pack-out. With *Philipino White*, growers commented that it also lacked a notable purple flesh colour, with the shape also problematic. Although some *Eclipse* roots had good flesh colour, it was variable, and growers were concerned about uneven set, shape and size.

All the new cultivars produced more total roots per plant than did *WSPF*; however, it appeared that most of these were in the unmarketable category (Table 45). Both *Eclipse* and *Philipino White* had a greater total weight of sweetpotatoes per hectare than did *WSPF*, with the increase in both marketable and non-marketable categories.

Table 45 Yield performance of Purple sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
WSPF	1.8	0.80	2.6	20.2	19.7	39.9
Eclipse	3.4	1.17	4.6*	27.2	24.9	52.0*
Molokai Purple	4.3*	0.90	5.2*	30.4	15.0	45.4
Philipino White	3.3	1.90	5.2*	26.9	34.7	61.6*
L.s.d	2.1	0.89	1.7	13.5	20.6	9.8

Philipino White produced more small marketable roots per plant than *WSPF*, which also transferred into a greater weight per hectare of small marketable sweetpotatoes (Table 46).

Table 46 Size grades of marketable Purple sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
WSPF	0.10	0.47	0.23	0.67	9.93	9.13
Eclipse	0.33	0.60	0.23	4.00	12.40	8.47
Molokai Purple	0.37	0.43	0.10	3.80	8.20	3.00
Philipino White	0.73*	1.03	0.13	8.00*	20.80	5.93
L.s.d	0.36	0.71	0.12	3.99	13.64	9.34

White category

In inspecting the White cultivars, growers liked the size and shape of *Kestle*, however expressed concern about shape and low numbers of roots set. In contrast, they were not approving of the poor shape and skin colour of *Whitestar*, and its low root set. As previously, growers disliked the sappy exudate of *Sumor* when cut, and how readily the skin marked.

There were no statistically detectable differences in roots set, productive yields or size gradings between the White cultivars (Table 47, Table 48).

Table 47 Yield performance of White sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Kestle	4.5	1.37	5.9	26.1	22.6	48.7
Sumor	6.4	1.73	6.4	29.9	24.5	54.4
Whitestar US	5.2	1.23	8.1	28.5	15.0	43.5
L.s.d	3.5	0.70	3.7	18.1	10.5	19.9

Table 48 Size grades of marketable White sweetpotatoes in Bundaberg 2012.

Holt 2012 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Kestle	0.80	0.50	0.07	8.1	12.7	1.7
Sumor	0.77	0.90	0.07	8.7	14.0	1.7
Whitestar US	0.60	0.63	0.00	4.7	10.3	0.0
L.s.d	0.74	0.22	0.12	8.6	11.3	3.1

Grower qualitative evaluations 2012

Grower collaborator	Eugenio Mizzi
Location	Lindeman's Road, South Kolan, Bundaberg, QLD
Planting season	Summer
Cultivars	*Northern Star, Kate, Smith's Red and Southern Star*
Planting date	6 December 2011
Commercial harvest	May 2012

Grower comments

The grower liked *Northern* Star best as it does well in the grey sandy soil at this site. They liked *Smith's Red* as it had a nice shape, but it had smaller roots than *Northern Star* and its yield was lower. *Kate* and *Southern* Star had the lowest yield.

Grower collaborator	Reid Tucker
Location	Lindeman's Road, South Kolan, Bundaberg, QLD
Planting season	Summer
Cultivars	*Northern Star, Kate, Smith's Red and Southern Star*
Planting date	6 December 2011
Commercial harvest	May 2012

Grower comments

The grower liked *Northern Star*, didn't think any of the other cultivars yielded better than *Northern Star* on grey sandy soil.

Grower collaborator	Sam Tully
Location	Reardon's Road Cudgen
Planting season	Winter
Cultivars	*WSPF, Eclipse, Molokai Purple, and Philipino White*
Planting date	17 January 2012
Commercial harvest	September 2012

Grower comments

The grower liked *Eclipse* better, as *Philipino White* roots were long, skinny and bendy and didn't crop as well, while *Molokai Purple* had a very low yield. *Eclipse* seemed to be a shorter sweetpotato with fewer eyes than *WSPF* and a smoother skin. *Eclipse* roots were also set higher than *WSPF* roots, which were set deep. This made harvesting the *Eclipse* a lot easier.

Grower collaborator	Rodney Wolfenden
Location	Rossmoya Rockhampton
Planting season	Winter
Cultivars	*WSPF, Molokai Purple, Philipino White and Eclipse*
Planting date	9 February 2012
Commercial harvest	June 2012

Grower comments

The grower felt all cultivars had low yields.

Grower collaborator	Darren Zunker
Location	Windemere Road Bundaberg
Planting season	Winter
Cultivars	*Beauregard, B63, Northern Star, Kate and Southern Star*
Planting date	10 February and 13 March 2012
Commercial harvest	September 2012

Grower comments

The grower liked *B63*, with good shape and yield, but didn't see any advantage over *Beauregard*. *Southern Star* and *Kate* grew too large and became non-marketable, while *Northern Star* had growth cracks.

Cultivar review and consolidation 2012

As in 2011, in 2012 growers and industry personnel attended joint field days with Russell McCrystal and Project VG09052 at the Bundaberg and Cudgen sites at commercial harvest. Almost 100% of sweetpotato growers and allied industry people attended the respective events, held at the Moore Park Road (Bundaberg) site in April 2012, the Reardon's Road (Cudgen) site in August 2012 and the Rubyanna's Road (Bundaberg) site in September 2012.

Growers and lead marketers took part in the assessment of the 16 cultivars at each site (Fig. 10). The evaluation criteria used for the on-site assessment was established as part of the Year 1 market survey and was further refined in the Year 2 evaluations/discussions. Growers and marketers evaluated the cultivars in the field, filling out assessment sheets on selection criteria, with the focus based on consumer-oriented characteristics such as shape, size range, skin and flesh colour, as well as estimates of potential productivity and suitability for commercial production.

Figure 10 **Sweetpotato industry stakeholders inspecting and evaluating sweetpotatoes at industry field days in Bundaberg and Cudgen, 2012.**

We facilitated grading exercises at each site with both growers and marketers (Fig. 11). We encouraged interaction via a 'sorting' activity, where participants graded roots into size categories and defined marketable and non-marketable traits for each of the colour categories, and their fit with consumer preferences. This also provided an understanding of supply chain issues by all parties and developed relationships for faster future commercialisation of new cultivars.

Figure 11 **Sweetpotato industry stakeholders grading sweetpotatoes at industry field days in Bundaberg and Cudgen, 2012.**

We sent samples of 8 key cultivars to major sweetpotato marketers in Sydney, Melbourne and Brisbane, who had been unable to attend evaluation site assessments. We asked their opinions of the cultivars, and their comments on positioning selected cultivars as stand-alone products.

As a result of all the interactions with sweetpotato stakeholders in 2012, we further refined size gradings for small sweetpotatoes, reducing the minimum weight by 50 g, minimum length and diameter by 10 mm(Table 49), as well as noted there were also small roots sold in prepacked 1 kg bags.

Table 49 **Shape and size grading for classifying sweetpotatoes, updated in 2012.**

Sweetpotato size grading	Weight	Length	Diameter
Small	150 – 400 g	120-180 mm	40-60 mm
Medium	400 – 800 g	180-240 mm	60-80 mm
Large	>800 g	>230 mm	>80 mm

Cultivar consolidation

At the industry/project meetings, after the final 2012 Bundaberg field day, the project team ASPG Technical Group, and allied industry stakeholders reviewed the field performance and sweetpotato quality assessments undertaken that year. There was substantial consideration given to grower comments and perspectives on cultivars, as they are the people who make the ultimate decision about what materials they will purchase and use.

The following cultivars were eliminated from the 2013 evaluation process:

Gold category

Regal, as this cultivar consistently demonstrated production of large numbers of long, skinny sweetpotatoes, with a purple dominated skin, which meant most product was unmarketable.

Red category

Kate, as this cultivar generally demonstrated almost identical characteristics to Southern Star, but was also generally lower yielding.

Purple category

Molokai Purple, as this cultivar had consistently lower yields, with poor shape.

White category

Through the evaluations, all the potential cultivars demonstrated problems at various times, and overall were certainly no better than the industry standard Kestle. Industry stakeholders also commented that the market for White sweetpotatoes was minimal and declining. Thus, we decided to discontinue further evaluations in this category

The group determined to proceed with the following 9 cultivars for the final year, grower evaluations.

Gold category – *Beauregard* (industry standard), *Evangeline, Bienville, B63*

Red category – *Northern Star* (industry standard), *Murasaki, Southern Star*

Purple category – *WSPF* (industry standard), *Philipino White, Eclipse*

White category – discontinued

We identified growers who were willing to participate in larger farmer field evaluations in the final year of the project.

Bulked planting material for final stage evaluations

We bulked up Pathogen-Tested tissue culture plantlets of 40 cultivars held in the germplasm bank in vitro in May 2011. After approximately 3 months growth, we de-flasked these plants into individual planting tubs in an insect screened (quarantine meshed) tunnel house at Gatton Research Facility in August 2011 to produce cuttings. After the decision in November 2011 to reduce the number of cultivars forwarded for further evaluation, we reduced the number of plantings in the tunnel house to 20 cultivars. Recall that bulking the planting materials has to commence preparation the year before the evaluations are due.

Standardised cuttings for the 16 cultivars selected for second stage evaluation were removed from these PT tested plants in the tunnel house in December 2011 and planted into individual plots. As previously, each plot was approximately 3 m long (depending on the number of initial cuttings available) and 1 row wide, with an inter-row spacing of 1.5 m. We planted cuttings 30 cm apart, and grew them using standard grower agronomy (irrigation, nutrition, pest management). We observed cultivar characteristics, including vine growth rates, vigour, habits and susceptibility to insect pests and bacterial and fungal diseases over the life of the crop, and documented them, to provide detailed germplasm accession data for future use.

We harvested roots from this bulking experiment in June 2012. We again collected basic data on cultivar characteristics, such as the number of roots produced, the shape of the roots and the skin and flesh colour and dry matter content. We over-wintered the roots at Gatton Research Facility in sheds at approximately 12 ^{o}C.

Plantbed supply of cuttings for final stage evaluations

We took the stored roots from the bulking experiment and planted them into 16 individual seedbeds at Gatton Research Facility in August 2012, to produce the vegetative planting material for the final stage evaluations. Note that at this stage, the second stage evaluations were still underway, so no assumptions could be made as to what cultivars would be tested in the following year.

We observed vine growth for vigour, habit and susceptibility to insect pests, bacterial and fungal diseases over the life of the planting beds.

Final stage cultivar grower evaluation experiments in 2012-13

In these experiments, we evaluated the 10 cultivars in the 3 distinct skin/flesh combinations:

- 4 Gold category cultivars – *Beauregard, B63, Bienville, Evangeline,*
- 3 Red category cultivars – *Northern Star, Murasaki, ;Southern Star,*
- 3 Purple category cultivars – *WSPF, Eclipse, Philipino White,*

We harvested cuttings for each of the cultivars from the Gatton Research Facility sweetpotato planting beds 24 hours before planting, on several occasions in November 2012, December 2012 and January 2013. We targeted premium cuttings 30-35 cm long with 3 nodes in the 15 cm of the cutting proximal to the tip. Most cultivars under evaluation had short internode spaces, with 4-5 nodes in this proximal section.

We prepared cuttings for planting by bunching the required number of cuttings for each plot (20) and tying with string, then wrapping the cut ends to a depth of about 20 cm in damp hessian bags for transport to the experimental sites. We prepared extra cuttings to allow for vine breakages and damage during transport and planting.

Grower co-operators planted the cultivars they chose to evaluate in Cudgen in November 2012, Bundaberg in December 2012, and Bundaberg and Rockhampton in January 2013. They used large commercial sized plots, often several rows wide and 20-40 m long. Growers flat-planted cuttings at 20 cm (8 inch) spacing as per current grower practice. Weeding hilling, fertiliser and pesticide application were applied by the cooperating grower, using their standard commercial practices.

For assessment at the commercial harvesting stage, we used the following procedure to evaluate yields and quality grades. We dug up the roots from 3 samples of 5 plants per plot. We sorted the roots into the various marketable grades, as well as non-marketable roots. We also noted any quality issues, including cracking, disease, insect or nematode damage. We classified and graded the sweetpotato roots according to the methodology described for the first stage evaluations.

Grower evaluation experiments in 2013

Gold category

Cudgen 2013

Grower collaborator	Matthew Prichard
Location	Cudgen Road, Cudgen, NSW
Planting season	Summer
Cultivars	*Beauregard, B63, Bienville and Evangeline*
Planting date	20 November 2012
Commercial harvest	7 May 2013 (168 DAP)

Grower comments

Beauregard had good yield and shape; however, it presented many large sized roots. Growers were concerned about susceptibility to nematodes and scurf. Overall rating 4.5 out of 5.

B63 looked to be a bit more consistent in shape than *Beauregard*. Growers were still concerned about susceptibility to nematodes and scurf. Overall rating 4.5 out of 5.

Bienville presented with nice shape and colour, with fewer large sweetpotatoes. It had a major problem with too many split roots. Overall rating 2.0 out of 5.

Evangeline presented with good shape and colour, consistent medium sized roots, with less large roots. It appeared to be slightly lighter in weight than *Beauregard*, with less overall pack-out. Overall rating 4.0 out of 5.

Sweetpotato performance

Bienville and *Evangeline* produced more total roots per plant than *Beauregard* did, however these were predominantly in the unmarketable category (Table 50). *Bienville* had a much greater weight of unmarketable sweetpotatoes than *Beauregard* did, and thus a lesser weight of marketable sweetpotatoes per hectare. About 9% of the *Bienville* roots were split, whilst only 0.6% of *Evangeline* sweetpotatoes split at harvest.

Table 50 Yield performance of Gold sweetpotatoes in Cudgen 2013.

Prichard 2013 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Beauregard	1.5	3.8	5.4	7.0	62.3	69.3
B63	1.1	4.6	5.7	4.6	78.2	82.9
Bienville	6.1*	2.9	9.0*	28.6*	31.8*	60.5
Evangeline	4.0*	3.5	7.5*	11.0	50.1	61.1
L.s.d	1.9	1.3	1.9	11.2	16.4	14.6

Whilst there were no detectable statistical differences between the size gradings between the cultivars (Table 51), it was noticeable that *Bienville* did not produce any large marketable roots.

Table 51 Size grades of marketable Gold sweetpotatoes in Cudgen 2013.

Prichard 2013 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	1.2	2.1	0.4	9.9	37.6	14.8
B63	2.1	1.9	0.6	20.8	36.7	20.8
Bienville	1.9	1.0	0.0	15.2	16.6	0.0
Evangeline	1.7	1.5	0.3	13.0	28.0	9.0
L.s.d	1.1	1.0	0.4	10.7	16.3	15.0

Bundaberg 2013

Grower collaborator	Darren Zunker
Location	Windemere Road, Bundaberg, QLD
Planting season	Summer
Cultivars	*Beauregard, B63, and Evangeline*
Planting date	12 December 2012
Commercial harvest	19 June 2013 (189 DAP)

Grower comments

B63 looked to be the same as *Beauregard*, so why grow it?

Evangeline presented with good shape, colour, and size, with no evidence of splitting.

Sweetpotato performance

Evangeline produced fewer total and marketable roots per plant and less total weight of sweetpotatoes per hectare than *Beauregard* (Table 52). However, the weights of marketable sweetpotatoes per hectare were similar across all the cultivars.

Table 52 Yield performance of Gold sweetpotatoes in Bundaberg 2013.

Zunker 2013 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Beauregard	3.4	7.6	11.0	18.4	103.3	121.7
B63	2.8	6.5	9.4	12.9	101.7	114.7
Evangeline	2.9	5.0*	8.0*	10.3	92.9	103.3*
L.s.d	1.5	1.3	1.9	11.0	22.0	14.2

Evangeline had a lesser weight of medium marketable sweetpotatoes per hectare than did *Beauregard* (Table 53).

Table 53 Size grades of marketable Gold sweetpotatoes in Bundaberg 2013.

Zunker 2013 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Beauregard	3.0	3.5	1.1	20.6	103.3	22.2
B63	2.2	3.7	0.6	15.9	101.7	23.0
Evangeline	1.9	2.3	0.8	13.6	92.9*	38.4
L.s.d	1.2	1.5	1.3	9.1	22.0	21.2

When the collaborating grower packed out the evaluation area, he recorded the following volumes of 18 kg cartons from the 22 m of harvested row per cultivar (Table 54).

Table 54 Grower pack out of Gold sweetpotatoes in Bundaberg 2013 (harvested 22 m of row).

Zunker 2013	Sweetpotato marketable grade						
Cultivars	Small	Small/ medium	Medium	Medium/ large	Large	No 2	Total
Beauregard	1	1	10	3	2	2	19
B63	1	1	8	2	1	2	15
Evangeline	1	1	6	3	2	0	13

Red category

Cudgen 2013

Grower collaborator Ken Small

Location Tweed Coast Road, Cudgen, NSW

Planting season Summer

Cultivars *Northern Star, Murasaki and Southern Star*

Planting date 13 November 2012

Commercial harvest 4 April 2013 (142 DAP)

Grower comments

This evaluation was located on a previously drained peat swamp and was extensively flooded. Consequently, we only observed fibrous roots and rotted roots at harvest in *Northern Star* and *Murasaki*, while *Southern Star* produced a few small to medium roots.

No other useful data was available to be collected from this evaluation.

Bundaberg 2013 A

Grower collaborator	Eugenio Mizzi
Location Bundaberg, QLD	Lindeman's Road, South Kolan,
Planting season	Summer
Cultivars	*Northern Star, Murasaki and Southern Star*
Planting date	12 November 2012
Commercial harvest	Not harvested

Grower comments

This evaluation was extensively flooded in January 2013. More cuttings were replanted several weeks later however all plots were then destroyed by birds.

No other useful data was available to be collected from this evaluation.

Bundaberg 2013 B

Grower collaborator Reid Tucker

Location Lindeman's Road, South Kolan, Bundaberg, QLD

Planting season Summer

Cultivars *Northern Star, Murasaki and Southern Star*

Planting date 12 November 2012. Replanted early February (date uncertain)

Commercial harvest 10 July 2013

Grower comments

This evaluation was extensively flooded in January 2013. More cuttings were replanted several weeks later; however, it was again subject to waterlogging. *Southern Star* appeared to perform better in the flooded areas than *Northern Star*. *Murasaki* has only a single skin and therefore damage to skin was more noticeable and less acceptable to market and consumers.

Sweetpotato performance

There were no statically detectable differences in sweetpotato yields or quality grades between the cultivars in this evaluation (Table 55, Table 56).

Table 55 Yield performance of Red sweetpotatoes in Bundaberg 2013.

Tucker 2013 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
Northern Star	2.8	1.2	4.0	21.4	18.0	39.4
Murasaki	4.1	1.7	5.8	15.8	18.3	34.1
Southern Star	1.5	1.9	3.4	12.6	32.5	45.2
L.s.d	2.9	1.2	2.2	13.6	13.7	11.5

Table 56 Size grades of marketable Red sweetpotatoes in Bundaberg 2013.

Tucker 2013 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
Northern Star	0.4	0.5	0.2	3.0	7.9	6.9
Murasaki	1.2	0.5	0.0	9.3	9.0	0.0
Southern Star	0.6	0.8	0.4	5.4	13.8	13.2
L.s.d	1.0	0.5	0.4	9.2	7.7	12.0

Purple category

Cudgen 2013

Grower collaborator	Sam Tully
Location	Reardon's Road, Cudgen, NSW
Planting season	Summer
Cultivars	*WSPF, Eclipse and Philipino White*
Planting date	12 November 2012
Commercial harvest	7 May 2013 (176 DAP)

Grower comments

This evaluation was located on a site with no additional fertiliser applied. Most of the cultivars produced smaller roots than expected. All cultivars showed good purple flesh colours (Fig. 12). Each cultivar also had good shape and yields, with overall ratings 4.0 out of 5.

Figure 12 Flesh colour comparisons of Purple category cultivars from Cudgen, 2013.

Sweetpotato performance

There were no statically detectable differences in overall sweetpotato yields in this evaluation, although *Eclipse* did perform very well (Table 57). *Eclipse* produced more medium marketable roots, and a greater weight of medium marketable roots per hectare than the industry standard *WSPF* (Table 58).

Table 57 Yield performance of Purple sweetpotatoes in Cudgen 2013.

Tully 2013 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
WSPF	3.1	3.8	6.9	12.4	36.2	48.3
Eclipse	3.0	4.3	7.3	8.8	46.8	55.6
Philipino White	3.4	3.4	6.8	13.3	34.0	47.3
L.s.d	1.7	2.0	3.3	6.5	17.6	19.0

Table 58 Size grades of marketable Purple sweetpotatoes in Cudgen 2013.

Tully 2013 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
WSPF	2.9	0.8	0.0	21.2	13.4	1.6
Eclipse	2.7	1.5*	0.0	21.6	23.8*	1.4
Philipino White	2.7	0.7	0.0	22.1	10.5	1.3
L.s.d	1.5	0.6	0.1	10.3	8.6	4.7

Bundaberg 2013

Grower collaborator	Brendan and Michael Peterson
Location	Gin Gin Road, South Kolan, Bundaberg, QLD
Planting season	Summer
Cultivars	*WSPF, Eclipse and Philipino White*
Planting date	17 December 2012
Commercial harvest	13 June 2013 (178 DAP)

Grower comments

All cultivars showed similar, good purple flesh colours (Fig. 13).

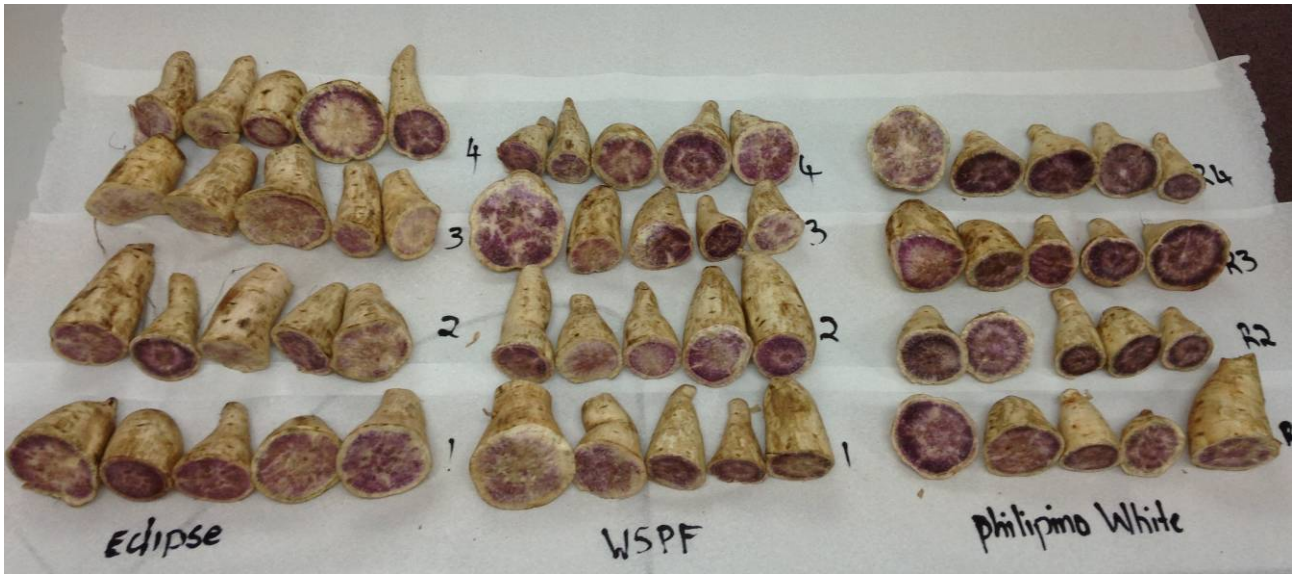


Figure 13 Flesh colour comparisons of Purple category cultivars from Bundaberg, 2013.

Sweetpotato performance

In this evaluation, *Eclipse* produced more marketable roots per plant, and a greater weight of marketable roots per hectare, than did *WSPF* (Table 59). *Philipino White* also appeared to produce a greater proportionate weight of its roots in the small and medium marketable root categories (Table 60).

Table 59 Yield performance of Purple sweetpotatoes in Cudgen 2013.

Peterson 2013 Cultivars	Non Marketable root number (per plant)	Marketable root number (per plant)	Total root number (per plant)	Non Marketable weight (t/ha)	Marketable weight (t/ha)	Total weight (t/ha)
WSPF	2.3	1.9	4.2	12.3	38.0	50.4
Eclipse	2.0	1.6	3.7	17.6	26.8	44.5
Philipino White	1.9	3.1*	5.0	11.1	47.2*	58.3
L.s.d	1.1	1.0	1.3	9.8	14.1	7.1

Table 60 Size grades of marketable Purple sweetpotatoes in Cudgen 2013.

Peterson 2013 Cultivars	Small marketable root number (per plant)	Medium marketable root number (per plant)	Large marketable root number (per plant)	Small weight (t/ha)	Medium weight (t/ha)	Large weight (t/ha)
WSPF	0.5	1.0	0.3	4.0	18.2	15.8
Eclipse	0.6	0.8	0.2	6.0	14.6	6.2
Philipino White	1.4	1.5	0.1	13.0	29.1	5.0
L.s.d	0.9	0.9	0.3	9.6	18.8	18.4

Grower qualitative evaluations 2013

Grower collaborator	Troy Prichard
Location	Elliot Heads Road, Bundaberg
Planting season	Winter
Cultivars	*Northern Star, Murasaki, Southern Star, WSPF and Philipino White*
Planting date	16 January 2013
Commercial harvest	20 September 2013

Grower comments

In their chocolate red soil, the grower felt that *Philipino White* had darker purple flesh than *WSPF*. He noticed growth cracks in *Northern Star*, however didn't feel the other Red cultivars were yet good enough to replace it. *Murasaki* set a lot of fibrous roots and low numbers of thin roots. *Southern Star* had nice shape and nice white flesh, but did not produce consistent yield.

Southern Star

Northern Star

Murasaki

WSPF

Philipino White

Grower collaborator	Rodney Wolfenden
Location	Rossmoya, Rockhampton, QLD
Planting season	Summer
Cultivars	*Beauregard, B63, Evangeline, Bienville*
Planting date	June 2013
Commercial harvest	January 2014

Grower comments

In this evaluation, the grower felt *Evangeline* did not yield as well as *Beauregard*. *Evangeline* had smaller roots overall (in the premium medium size range), and they did not split.

Grower collaborator	Ashley Zelinski
Location	Lake Clarendon, QLD
Planting season	Winter
Cultivars	*Beauregard, Evangeline, Bienville, Southern Star*
Planting date	15 February 2013
Commercial harvest	August 2013

Evangeline

Grower comments

This observation was before commercial harvest, so all roots were long, skinny and undersized. No fertiliser had been applied to this site, so the grower felt the cultivars may fill out in Spring.

Grower collaborator	Ernie Jowatt
Location	Elliot Heads Rd, Bundaberg QLD
Planting season	Summer
Cultivars	*Northern Star, Southern Star*
Planting date	September 2013
Commercial harvest	January 2014

Grower comments

This grower felt *Northern Star* was the better overall, (the colour was much redder, and the yield was higher). *Southern Star* was more bronze looking and had some sweetpotato weevil and nematode damage. *Northern Star* also had nematode damage.

Northern Star

Southern Star

Final cultivar review 2013

We held highly successful joint field days for projects VG09052 (McCrystal Consultancies) and VG09009 at Cudgen on 14 May 2013 (Fig. 14), and in Bundaberg on 12 June 2013 (Fig. 15). We visited many of the previously described grower field evaluations, as part of the harvests at these sites. Growers evaluated individual sweetpotato cultivars in the field and compared the cultivars for marketability and production. Industry stakeholders also participated in taste testing some of the better performing cultivars in the Gold and Purple categories. We sent samples of the better performing sweetpotatoes to market agents for evaluation and comment.

Figure 14 **Growers participating in the final cultivar evaluations, Cudgen, 2013.**

Figure 15 **Growers participating in the final cultivar evaluations, Bundaberg, 2013.**

Cultivar information and performance summaries

The following sheets summarise the positive and negative attributes of the sweetpotato cultivars evaluated during this project. They include known characteristics from previous studies, as well as performance details and industry commentary obtained during the project.

The project team believe that growers and allied industry will continue to explore opportunities for including new cultivars in their portfolio. Rather than be prescriptive about what cultivars to grow, we feel best placed to provide local information, to help producers make informed choices to suit their markets and circumstances. However, we have ordered the cultivars; with the industry standard described first, followed by the cultivars more likely to be innovated into sweetpotato supply chains.

Gold category

Beauregard

Beauregard

Current industry standard gold fleshed cultivar

Good points

- Solid rose-gold skin colour
- Smooth easy to peel skin
- Market desirable even shape and size
- Produces a high percentage of marketable roots
- Consistently high yielding across a range of climatic conditions and soil types
- A medium maturing plant, harvested 18-20 weeks after planting
- Resistant to Fusarium wilt soil rot and Rhizopus soft rot
- Moderately resistant to Soil rot and Sclerotial blight
- Harvest date can be varied by increasing plant density (harvest later) or decreasing plant density (harvest sooner)

Bad points

- Highly susceptible to soil insects and nematodes
- Susceptible to scurf
- Can produce a high proportion of large-sized roots
- Susceptible to breakdown under prolonged waterlogged conditions
- Highly susceptible to SPFM virus infection

Industry rating: 4.5 out of 5.

Evangeline

Evangeline

Deep red-gold skin, with intense orange flesh colour. *Evangeline* was imported from the USA Louisiana State University Sweetpotato Research Station. This cultivar was selected out of the breeding program, in response to crop losses through high rainfall and waterlogging, during Hurricane Katrina. *Evangeline* was said to be more tolerant of water logging than some other gold-fleshed cultivars grown in Louisiana at the time.

Beauregard

Industry comments: Darker coloured skin than *Beauregard*, with a pleasing dark orange flesh colour, nice shape and size, consistent medium sized roots, and less large roots. Seems to have good nematode resistance and good skin toughness and don't skin as easily as *Beauregard*. Lower yield than *Beauregard* at some sites, and occasionally larger eyes, which the market doesn't like. Overall size of sweetpotatoes is smaller than *Beauregard*. Some cracking was observed in a few evaluations. Growers interpreted that although yields may be lighter than *Beauregard* on occasions, there may be suitable returns if there are more premium quality pack-outs. There is concern about the skin turning more purple in cold conditions.

Good points

- Smooth skin with a deep rose-gold skin colour that is appealing to growers and consumers
- Darker orange flesh colour than *Beauregard*
- Skin is tougher and thus more resistant to damage
- Increased tolerance to breakdown under water logged conditions
- Large number of roots set per plant
- Highly resistant to Root knot nematode, resistant to Fusarium wilt, Fusarium root rot and Rhizopus soft rot
- Moderately resistant to Soil rot
- Little to no soil insect damage was observed in this cultivar at sites where damage was observed in the current industry standard *Beauregard*

Bad points

- Some skin cracking was seen upon harvesting at some sites
- Eyes can be larger and more obvious than *Beauregard*
- Susceptible to Sclerotial Blight
- On occasions, if the cultivar develops a more purple dominated red-gold skin, this may create confusion with Red category cultivars by wholesalers and consumers

Industry rating: 4 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)						
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 10**	**Exp 11**
Beauregard	52.0	13.3	30.7	76.3	57.3	62.3	103.3
Evangeline	5.3	27.5	44.3	38.5*	36.7*	50.1	93.0*
% of Standard	10%	208%	145%	50%	64%	80%	90%

On a few occasions, *Evangeline* exhibited cracking immediately upon harvest at Cudgen and Bundaberg but not in the planting material bulking plots in Gatton. Evangeline certainly seems less prone to the splitting issue than *Bienville*. *Evangeline* produced a higher weight of marketable roots in Experiments 2 and 3 though these differences were not statistically detectable. *Beauregard* roots at these sites were severely damaged due to nematode infection and therefore many were unmarketable. *Evangeline* produced significantly less marketable roots per hectare than *Beauregard* in Experiments 4, 5 and 11, due to overall size being smaller than *Beauregard* roots and/or splitting of roots upon harvest. Industry is hopefully that agronomic refinement may improve the yields performance of *Evangeline*. Of the Gold cultivars evaluated in this project, *Evangeline* appears the most promising to be expanded in production to create a new, niche Gold sweetpotato. At this stage, it is unlikely to replace *Beauregard* as the main growing cultivar.

B63

B63

Rose-gold skin, with a moderately deep orange flesh. *B63* is a *Beauregard* clone developed by the Louisiana State University sweetpotato breeding program and was imported into Queensland in 2007.

Industry comments: Looks to be the same as *Beauregard*. *B63* seemed to have a bigger marketable yield than *Beauregard* did in some experiments. Its shape and flesh colour is good, with productive yields. Growers differed in their views on the consistency of shape and size compare to *Beauregard*. A common perspective was that *B63* has the same genetics as *Beauregard* so why should we grow it, as it will be susceptible to the same pests and diseases as *Beauregard*.

Beauregard

Good points:

- Yield and consistency of shape and size, was very similar to *Beauregard* on all experimental sites
- Smooth easy to peel skin with a rose gold colour
- Solid orange flesh colour
- Resistant to Fusarium wilt soil rot and Rhizopus soft rot
- Moderately resistant to Soil rot and Sclerotial blight

Bad points:

- Highly susceptible to soil insects and nematodes
- Susceptible to scurf
- Possibly susceptible to breakdown under prolonged waterlogged conditions
- Susceptible to SPFMV infection

Industry rating: 4.5 out of 5.

Experimental performance

	Marketable roots produced (tonnes per hectare)						
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 10**	**Exp 11**
Beauregard	52.0	13.3	30.7	76.3	57.3	62.3	103.3
B63	46.7	13.7	27.5	64.6	42.9*	78.3*	101.8
% of Standard	90%	103%	90%	85%	75%	126%	99%

B63, a *Beauregard* clone, performed similarly to *Beauregard* across all experiments. However, *B63* produced a lesser weight of marketable roots than *Beauregard* in Bundaberg 2012 (Exp. 5), and a greater weight of marketable roots than *Beauregard* in Cudgen 2013 (Exp 10).

Bundy Gold

Bundy Gold

Rose/gold smooth skin, with even orange flesh. A grower *Beauregard* selection, collected in 2001 at Bundaberg.

Industry comments: The same as *Beauregard*, so doesn't really meet industry desire for a different Gold sweetpotato.

Beauregard

Good points

- Good yield and shape
- Smooth, easy to peel skin with a rose-gold skin colour
- Solid orange flesh colour

Bad points

- Slightly more uneven shape than *Beauregard*
- Highly susceptible to soil insects and nematodes, susceptible to scurf
- Susceptible to breakdown under prolonged waterlogged conditions
- Highly susceptible to SPFM virus infection

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Beauregard	52.0	13.3
Bundy Gold	62.7	20.9
% of Standard	121%	157%

This cultivar was dropped from further experiments, as there was little grower interest in pursuing its evaluation, given its similarity to *Beauregard*. The yield performance differences between *Bundy Gold* and *Beauregard* were not statistically detectable.

Cudgen Gold

Cudgen Gold

Rose/gold smooth skin, with even orange flesh. A grower *Beauregard* selection collected at Cudgen by growers in 2011.

Industry comments The same as *Beauregard*, so doesn't really meet industry desire for a different Gold product.

Good points

- Good yield and smooth, even shape
- Smooth, easy to peel skin with a rose gold skin colour
- Solid orange flesh colour
- Consistently smooth shape and even size

Beauregard

Bad points

- Highly susceptible to soil insects and nematodes, susceptible to scurf
- Susceptible to breakdown under prolonged waterlogged conditions
- Highly susceptible to SPFM virus infection

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Beauregard	51.9	13.2
Cudgen Gold	89.9	23.8
% of Standard	173%	180%

This cultivar was dropped from further experiments, as there was little grower interest in pursuing its evaluation, given its similarity to *Beauregard*. The yield performance differences between *Cudgen Gold* and *Beauregard* were not statistically detectable.

Figure 16 **Large cracks and pimpling damage caused by nematode infection in cultivar Cudgen Gold in Experiment 2.**

Bienville

Bienville

Rose-red skin, uniform moderate to dark orange flesh. *Bienville* was imported from the USA. This cultivar was selected from the sweetpotato breeding program managed by Don Labonte at the Louisiana State University Sweetpotato Research Station.

Industry comments: This cultivar has a nice shape and size distributions, with less large sweetpotatoes. The colour is usually very attractive as a deep red-gold, and didn't skin as easily as *Beauregard* in early evaluations. It seemed to be less impacted than *Beauregard* by soil insects.

The major concern was lower yields than *Beauregard* on occasions, and a propensity for roots to split before or at harvest.

Beauregard

Good points

- Smooth skin with a deep rose-gold skin colour that is appealing to growers and consumers
- Solid dark orange flesh colour
- Very large number of roots set per plant, primarily due to short internodes
- Resistant to Root knot nematode, Fusarium wilt, Fusarium root rot and Rhizopus soft rot
- Moderately resistant to Bacterial root rot

Bad points

- Skin cracking was observed upon harvesting at most evaluation sites
- Slower maturing than *Beauregard*, with higher number of roots produced due to smaller inter-nodal spaces. May require different agronomic management to fill sweetpotatoes successfully

Industry rating: 2 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)					
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 10**
Beauregard	52.0	13.3	30.7	76.3	57.3	62.3
Bienville	16.7	17.5	33.5	53.3*	32.4*	31.9*
% of Standard	32%	132%	109%	70%	57%	51%

Bienville produced lesser weights of marketable roots in Experiments 4, 5 and 10, due to many roots either being split or too small for the marketable category. Although not statistically different, *Bienville* produced 132% and 109% more marketable roots than *Beauregard* in Experiments 2 and 3, where there was high nematode pressure. *Bienville* having smaller internode spaces, and therefore more nodes in the last 200 mm of the planted cutting area (4-5, compared to 3 in Beauregard) had the potential to set more roots than *Beauregard*; however, this was not always the case. Where *Bienville* did set high numbers of roots, a higher number of small or undersized (non-marketable) roots were present at commercial harvest. This indicated that different planting densities, or extended harvesting times, may have been required to optimize performance of this cultivar. However, the susceptibility to splitting has limited Australian sweetpotato grower interest in this cultivar. If this could be overcome by better understanding of the issue, and management options, this cultivar may indeed become popular with growers and other value chain members.

Figure 17 Split Bienville roots at Cudgen Experiment 2.

Hernandez

Hernandez

Bright copper skin colour, with intense orange flesh colour. Imported from the USA. Developed by Louisiana State University in 1982. Grown commercially in Australia prior to the release of *Beauregard*.

Industry comments: Very nice skin colour and good deep orange flesh colour. Roots did not fill out as much as *Beauregard*. Replaced by *Beauregard*, so doesn't really meet industry desire for a new, improved Gold sweetpotato.

Beauregard

Good points

- Nice rose/copper skin colour, deep orange flesh colour
- Sets large root numbers
- Moderately resistant to Soil rot, Root knot nematode, Fusarium rot and Root rot

Bad points

- Slow to fill out roots
- Later maturing than *Beauregard*
- Susceptible to Bacterial root rot and Rhizopus soft rot

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Beauregard	52.0	13.3
Hernandez	64.7	21.4
% of Standard	124%	161%

Hernandez consistently set a high number of roots but was later maturing than *Beauregard* so roots were long and skinny; often placed into the non-marketable category. The yield performance differences between *Hernandez* and *Beauregard* were not statistically detectable. This cultivar was dropped from further experiments, as there was little grower interest in pursuing its evaluation, given its pre-dating *Beauregard*.

Figure 18 Hernandez showing high numbers of long and thin roots.

Darby

Darby

Rose-gold smooth skin, with orange flesh. Imported from the USA, developed by Louisiana State University Sweetpotato Research Station. One of the main commercial orange-fleshed cultivars grown in Australia prior to the release of *Beauregard*.

Industry comments: Acceptable skin colour and flesh colour, a bit dumpy**.** Replaced by *Beauregard*, so doesn't really meet industry desire for a new, improved Gold sweetpotato.

Beauregard

Good points

- Nice red-gold skin colour, and flesh colour
- Smooth skin

Bad points

- Slower maturing than *Beauregard*
- Can produce high numbers of large roots
- Prone to root breakdown in storage

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Beauregard	52.0	13.3
Darby	16.7	24.6
% of Standard	32%	185%

This cultivar was dropped from further experiments, as there was little grower interest in pursuing its evaluation, given its pre-dating *Beauregard*. The yield performance differences between *Darby* and *Beauregard* were not statistically detectable. *Darby* tended to produce larger roots that were shorter (dumpier) than *Beauregard* roots.

Regal

Regal

This cultivar has a red purple skin and orange flesh. *Regal* was imported by in 2007 from Georgia in the USA, by Russell Mc Crystal as part of VG05037. It was originally bred for increased tolerance to soil insects.

Industry comments: Industry liked the intensity of skin and flesh colour, but skin colour would create confusion with Red category cultivars by wholesalers and consumers. *Regal* set good numbers of roots, but size is too small, and the shape is too long and skinny. Growers felt *Regal* was unlikely to be commercially viable.

Beauregard

Good points

- Smooth, easy to peel skin with a deep rose purple skin colour
- Solid, dark orange flesh colour
- Very large number of roots set per plant
- Increased tolerance to soil insects and nematodes

Bad points:

- Large number of roots set per plant, leading to low yield and slow maturity
- Bulking roots were too small, long and skinny

Experimental performance

	Marketable roots produced (tonnes per hectare)				
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**
Beauregard	52.0	13.3	30.7	76.3	57.3
Regal	50.0	6.4	6.7*	14.6*	17.5*
% of Standard	96%	48%	22%	19%	31%

Regal consistently produced the greatest number of roots across all sites, but the cultivar struggled to fill those set roots, and they tended to be long and skinny. *Regal* was removed from final stage evaluations as industry feedback and data collected indicated this cultivar would not produce high yields, and therefore would not be commercially viable.

Figure 19 Cultivars Beauregard, (left) and Regal (right) showing purple skin colour in Regal.

Excel

Excel

Pale orange skin and even orange flesh. Developed by USDA and Clemson University. Imported from the USA in 2007 by Russ McCrystal for its tolerance to soil insects.

Industry comments: Growers felt this cultivars pale orange skin and very sappy exudate when cut would not be as appealing to consumers as *Beauregard*.

Beauregard

Good points

- Even orange flesh colour
- Soil insect tolerance

Bad points

- Pale skin colour
- Excess latex production (sappy)

Industry rating: 1 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Beauregard	52.0	13.3
Excel	48.0	23.9
% of Standard	92%	180%

Excel with soil insect and nematode tolerance produced 80% more marketable roots than *Beauregard* in Experiment 2 where nematode soil counts were high in all plots, but these improvements were not statistically detectable. *Excel* was excluded from further evaluation in this project, when industry feedback deemed it unsuitable for commercial markets. This was due to the undesirable characteristics of pale skin colour and excess latex production when cut.

Figure 20 Excel (left) and Beauregard (right) showing differences in skin colour.

Red category

Northern Star

Northern Star

Current industry standard, red skinned, white fleshed cultivar, making up around 10% of Australian sweetpotato production (2013). *Northern Star* has a red purple skin, with bright, white flesh including occasional purple areas. Its origins are Laloki, Papua New Guinea. Released in Queensland as part of project VG97023 in 2000.

Industry comments: It has a dual smooth skin, good yield, and even size. However, it also commonly has growth cracks, and some roots are too bent, with an ugly shape. Many growers suggest *Northern Star* therefore is only able to be grown at certain times of the year in some areas.

Good points

- High yielding early maturing
- Smooth bright purple/pink skin colour
- Clean crisp white flesh, with occasional purple flecks
- Good taste, strong double skin
- Very vigorous vine growth

Bad points

- Highly susceptible to growth cracks and shape deformities, ribbing and constrictions, and sunken lenticels, especially in presence of high rates of nitrogen fertiliser and on red soils
- Shape not always consistent
- Can tend to grow too large

Industry rating: 4 out of 5.

Southern Star

Southern Star

This cultivar has a red-purple double skin, and bright white flesh with occasional purple areas. We suspect it is a tissue culture mutation, possibly homologous to *Kate*.

Industry comments: *Southern Star* has a smooth, dual skin, with good yield, size, shape and colour. Growers commented it was not as commonly cracked as *Northern Star*, and seemed to perform better than *Northern Star* in waterlogged ground. Other growers were less enthusiastic; suggesting the consistency of yield, size, and shape was not there. Industry agreed that perhaps *Southern Star* needs to be harvested early, to prevent them growing too long. Growers were also concerned about the potential bronze hue in the skin, particularly if it was presented next to a brighter purple cultivar such as *Northern Star*.

Northern Star

Good points

- Early maturing
- Smooth deep purple-pink skin colour
- Clean white flesh with occasional purple flecks

Bad points

- Can tend to have lower root numbers than the industry standard
- Tends to grow too large and long, especially in red soil
- Skin colour sometimes has a bronze hue

Industry rating: 3 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)					
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 9**
Northern Star	24.3	14.5	15.0	22.5	11.5	18.0
Southern Star	36.7	16.4	21.3	42.6*	46.3*	10.1
% of Standard	151%	113%	142%	189%	404%	56%

Southern Star produced roots that tended to be much smoother in shape than *Northern Star* and slightly more of a reddish brown purple colour compared to *Northern Star*. Roots had white flesh with small purple areas. *Southern Star* produced significantly higher yields of marketable roots at some experimental sites. *Southern Star* matures earlier, especially when setting less roots than *Northern Star.* Roots can grow quite long and large if not harvested in a timely manner. Growers were undecided about small areas of purple flesh sometimes seen in *Southern Star*, compared to *Northern Star's* normal white flesh. Note that *Northern Star* can also have star-shaped areas of purple flesh under certain growing conditions, however this is less common. *Southern Star* is the cultivar worth exploring as an alternative Red category sweetpotato to *Northern Star*. The key agronomic issues to be advanced are maintaining a good shape and size, and preventing the roots from becoming bronze in hue.

Kate

Kate

This cultivar has a red-purple double smooth skin, with bright white flesh including small areas of purple. *Kate* was collected in Cudgen in 2004. it is thought to have originated from a naturally occurring poly-cross in the field, possibly between *Northern Star* and *Beauregard*.

Industry comments: *Kate* has good shape, and a pleasing white flesh, with a consistent, smooth double skin. Some growers believe this cultivar need to be harvested early, or its storage roots grow too long. Others are more critical, suggesting it is inherently too long, and the skin has too many bumps.

Northern Star

Good points

- Early maturing, smooth deep purple-pink skin colour
- Clean white flesh with occasional purple flecks

Bad points:

- Tends to grow too long
- Some constrictions and uneven shape

Industry rating: 2.5 out of 5.

Experimental performance

	Marketable roots produced (tonnes per hectare)				
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**
Northern Star	24.3	14.5	15.0	22.5	11.5
Kate	38.1	10.9	17.8	21.7*	19.9*
% of Standard	157%	76%	119%	96%	173%

Kate produced roots that tended to be smoother in shape than *Northern* Star and slightly more of a reddish-brown, purple colour compared to *Northern Star*. Roots had white flesh with small purple areas. Yields were not significantly different to *Northern* Star, but *Kate* was earlier maturing, especially if setting less roots than *Northern Star.* Roots tended to grow quite long and large. It seemed to perform very similarly to *Southern Star*, with no distinct advantages over that cultivar.

Murasaki – 29

Murasaki

This cultivar has a dark purple, single skin, with butter cream coloured flesh. It was imported from Louisiana State University Sweetpotato Research Station.

Industry comments: Growers felt *Murasaki* had good yield, with a more consistent root set than *Northern Star*. Although it looked appealing, the small size and shape of the sweetpotatoes were not as traditionally attractive, nor was the creamy flesh colour (compared to the white flesh of *Northern Star*). Growers were also concerned the single skin would mark more readily, and occasionally the flesh was a little sappy, both characteristics reducing market appeal.

Northern Star

Good points

- Rich, dark purple, smooth skin
- Sweeter tasting than *Northern Star*

Bad points

- Longer maturing variety, harvested roots were small at all sites
- Shape not always consistent, ribbing and constrictions were observed at some sites
- Single skin, prone to damage
- Butter coloured flesh

Industry rating: 2.5 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)					
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 9**
Northern Star	24.3	14.5	15.0	22.5	11.5	18.0
Murasaki - 29	24.5	9.5	16.3	26.9	30.7	18.3
% of Standard	101%	65%	109%	120%	268%	102%

This cultivar has darker purple skin than *Northern Star*. Growers thought this was less appealing than the bright, fuchsia coloured skin of *Northern Star*. Flesh colour was a creamy yellow (butter colour) which growers also thought would not be as desirable as the clean white flesh colour of *Northern Star*. *Murasaki-29* roots proved to be smaller overall than *Northern Star* and slower maturing than *Beauregard* in Australia. This has also been the case in Louisiana (Labonte, pers. comm.), where it matures at least a couple of weeks slower than *Northern Star*. *Murasaki* set similar root numbers to *Northern Star* but was very susceptible to rots and breakdown, or production only of fibrous roots in waterlogged soil. *Murasaki – 29* also produced roots with uneven shape in some experiments, but cooked flesh was much sweeter tasting than *Northern Star*. With the butter yellow flesh and sweeter taste, perhaps this cultivar would have to be introduced as a separate line to *Northern Star*, to become acceptable to wholesalers and consumers. It may be worth exploring as a stand-alone sweetpotato line, provided the agronomic issues could be sorted.

Smith's Red

Smith's Red

This cultivar has a red-purple double skin, with butter cream flesh. It was collected in the Mareeba district in 2006.

Good points

- Red-purple, double skin
- Smooth skin

Northern Star

Bad Points

- Prone to constrictions and uneven shape
- Butter coloured flesh, not white
- Sunken lenticels

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
Smith's Red	35.9	10.2
% of Standard	148%	71%

Smith's Red was very similar to *Red Red*; it also produced roots with a similarly coloured double skin like *Northern Star*, with a creamy yellow coloured flesh not as appealing to growers. Shape was also slightly bent, with occasional constrictions and sunken lenticels. Overall size and root numbers were less than *Northern Star*. Although *Smith's Red* out yielded *Northern Star* in Experiment 1, only 2 out of 3 plots were flooded, compared to 3 out of 3 plots for *Northern Star*. This cultivar was not progressed to second stage evaluations.

Red Red

Red Red

Good Points

- Dark purple, double skin
- Smooth skin

Bad points

- Butter coloured flesh, not white
- Shape abnormalities, uneven shape, including constrictions, lumps and bumps
- Inconsistency in size of roots

Northern Star

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
Red Red	12.2	0.0
% of Standard	50%	0%

Red Red produced roots with a similarly coloured double skin to *Northern Star*; however, flesh colour was a creamy yellow colour, not as desirable to growers. Shape was slightly bent, with occasional constrictions and sunken lenticels. Overall size and root numbers were less than *Northern Star*. Marketable yields were also lower than *Northern Star*. This cultivar was not progressed to second stage evaluations.

L46

L46

This cultivar has a deep purple, double skin, with white flesh. It originated in the Milne Bay area, Papua New Guinea.

Industry comments: Growers considered that *L46* had poor shape and yield, with inconsistent size, and too much overall variability.

Northern Star

Good points

- Deep purple, double skin
- Clean white flesh

Bad points

- Shape inconsistent
- Prone to forming longitudinal grooves, and bumps leading to uneven shape
- Flesh oxidises rapidly once cut

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
L46	9.5	1.7
% of Standard	39%	12%

Although this cultivar had a rich, purple coloured skin and white flesh, it was dropped from further experiments due to inconsistent and uneven shape, susceptibility to nematode infection and breakdown. The white flesh of *L46* also oxidised quickly once cut.

L11

L11

This cultivar has a deep purple, single skin, with white/cream flesh. It was collected in Central Province, Papua New Guinea**.**

Industry comments: *L11* has cracks, rots, bumpy skin, with sunken lenticels. It has overall poor shape, size and yield, with too much variation in performance.

Northern Star

Good Points

- Deep purple skin colour
- White flesh
- Vigorous vine growth smothering weeds

Bad Points

- Uneven shape, longitudinal grooves and constrictions
- Susceptible to nematode infection
- Growth cracks

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
L46	9.5	16.3
% of Standard	39%	113%

L11 was not included in second stage evaluations, due to uneven shape, growth cracks and sunken lenticels leading to low marketability.

Q953-3:1

Q953

This cultivar has a red-brown thin single skin, with bright white flesh. It was a breeding line selected in Mareeba by Lester Loader.

Good Points

- Sets large numbers of roots per plant
- Clean, white flesh colour
- Appealing taste when eaten raw

Northern Star

Bad Points

- Slow to fill out roots
- Single skin
- Pale tan to purple skin is not appealing
- Skin is soft and easily damaged
- Roots are very brittle, tending to snap easily

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
Q953	32.2	2.3
% of Standard	133%	16%

This cultivar produced high root numbers; however, sweetpotatoes were much slower to mature than *Northern Star*. At commercial harvest, roots were long and skinny. Its single purple to tan skin was very soft and easily damaged when handled. Marketable yields were considerably lower than *Northern Star*. For these reasons *Q953-3:1* was dropped from evaluations after the first year.

JRW

JRW

It has a red/purple single skin, with cream/yellow flesh. This cultivar was collected from a grower by Lester Loader, and is possibly of Japanese origin.

Industry comments: Growers did not like the performance or appearance of this cultivar.

Northern Star

Good points

- Deep purple skin colour
- Sweet tasting

Bad points

- Uneven shape
- Sunken lenticels with sometimes deep longitudinal grooves
- Susceptible to nematode infection
- Single skin
- Cream, off-white flesh

Experimental performance

	Marketable roots produced (tonnes per hectare)		
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**
Northern Star	24.26	14.47	30.7
JRW	12.20	0.00	33.5
% of Standard	50%	0%	109%

This cultivar was not included in second stage evaluations, because it did not produce any marketable roots in Experiment 2. *JRW* roots were unevenly shaped, and exhibited severe nematode infection. Growers also thought that this cultivar's butter coloured flesh would not be as appealing to consumers, who were used to purchasing *Northern Star* sweetpotatoes with clean white flesh.

Wanmun

Wanmun

This cultivar has a pale, translucent, red-purple to tan single skin, with cream to white coloured flesh.

Industry comments: Growers did not like the pointed ends on roots, nor the single skin. They also described the sweetpotatoes as ugly.

Northern Star

Good Points

- Vigorous vine growth
- White flesh

Bad points

- Uneven shape, susceptible to longitudinal grooving, and veins
- Single skin tends to tan colour at the base of the sweetpotato
- Roots narrow in shape towards base

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
Wanmun	20.5	5.3
% of Standard	85%	37%

Wanmun produced small, dumpy roots, with pointed ends in both experiments. *Wanmun* roots tended to be uneven in shape with longitudinal grooves, veins and sunken lenticels. *Wanmun* was susceptible to nematode infection and the single purple skin, faded in colour to tan at the base of the roots, making them look unappealing when compared to *Northern Star*. Marketable yields were lower than *Northern Star* and this cultivar was not evaluated in any further experiments.

NG7570

This cultivar has a red-purple single skin, with white flesh. It was originally from Nigeria.

Industry comments: Growers were unimpressed with this cultivar, indicating it had poor shape and yield, with inconsistency of size and too much overall variability.

NG7570

Northern Star

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Northern Star	24.3	14.5
NG7570	36.7	9.3
% of Standard	151%	65%

NG7570 was very susceptible to nematode infection and produced roots with a single skin and uneven shape with sunken lenticels. This cultivar was removed from evaluation early in the project for those reasons.

Figure 21 **NG7570 root showing damage, cracking and breakdown, because of early nematode infection.**

Purple category

WSPF

WSPF

This cultivar has a white skin, with white and purple flesh. It was released in Queensland as part of project VG 97023 in 2000. *WSPF* is the current Australian industry standard purple-fleshed cultivar, but makes up less than 2% of Australian sweetpotato production.

Industry comments: Growers generally liked its shape and yield, although it can be inconsistent. Its purple flesh colour varies between crops. It can sometimes fail to fill out properly.

Good points

- Compact vine, however has good ground cover therefore less weeds
- Smooth, white skin, with purple flesh

Bad points

- Shape not consistent
- Highly susceptible to constrictions and shape deformities
- Purple flesh colour not consistent

Industry rating: 3.5 out of 5

Eclipse

Eclipse

This cultivar has a white skin, with white and purple flesh. It was collected by Eric Coleman and William O'Donnell in Northern NSW in 2001.

Industry comments: Growers generally liked the shape and colour of *Eclipse*. They suspected it required more nitrogen fertiliser than other Purple category cultivars. Its root set, size and shape were not as consistent as Gold category sweetpotatoes, and however it usually was as good as the industry standard *WSPF*.

WSPF

Good points

- Compact vine, however has good ground cover therefore less weeds
- Smooth skin, with good purple flesh

Bad points

- Shape not always consistent, susceptible to constrictions and shape deformities
- Purple flesh colour not always consistent
- Sunken lenticels

Industry rating: 4 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)						
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 12**	**Exp 13**
WSPF	17.2	10.6	6.3	36.4	19.7	36.2	38.1
Eclipse	16.8	8.3	13.9	22.0	24.9	46.9	26.8
% of Standard	98%	78%	221%	60%	126%	129%	70%

Although *Eclipse* is prone to shape abnormalities such as constrictions, longitudinal grooves and sunken lenticels, this is often only to the same or a lesser extent to that of *WSPF*. *Eclipse* yielded similarly to *WSPF* in all evaluations. *Eclipse* sweetpotatoes at experimental sites sometimes displayed darker purple flesh colour than *WSPF,* though this was not always consistent. *Eclipse* set higher roots in grower observations than *WSPF*, making them easier to dig mechanically. With better understanding of the agronomic requirements to optimise the performance of *Eclipse*, it could be an improvement on the current industry standard. Along with *Philipino White*, the project team believes *Eclipse* could be the best interim Purple category cultivars, until germplasm with more consistent purple flesh, and agronomic performance become available.

Philipino White

Philipino White

WSPF

This cultivar has a white skin, with white and purple flesh. It was collected in Bundaberg in 2001.

Industry comments: *Philipino White* has a reasonable flesh colour, shape, skin and yield. Growers would prefer a slightly darker flesh colour with more consistency. Occasionally it also has issues with consistency of shape and yield.

Good points

- Compact vine, however has good ground cover therefore less weeds
- Smooth skin, with purple flesh

Bad points

- Shape not always consistent, susceptible to constrictions and shape deformities
- Purple flesh colour not always consistent

Industry rating: 3.5 out of 5

Experimental performance

	Marketable roots produced (tonnes per hectare)						
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**	**Exp 12**	**Exp 13**
WSPF	17.2	10.6	6.3	36.4	19.7	36.2	38.1
Philipino White	4.7	11.3	8.2	39.2	34.7	34.0	47.2*
% of Standard	27%	106%	131%	108%	176%	94%	124%

Philipino White produced more marketable roots than *WSPF* in Experiment 13, but not in the other evaluations. Although *Philipino White* is prone to shape abnormalities such as constrictions, longitudinal grooves and sunken lenticels, this is often only to the same or a lesser extent to that of *WSPF*. *Philipino White* roots at experimental sites sometimes displayed darker purple flesh colour than *WSPF,* though this was not always consistent. With better understanding of the agronomic requirements to optimise the performance of *Philipino White*, it could be an improvement on the current industry standard. Along with *Eclipse*, the project team believes *Philipino White* could be the best interim Purple category cultivars, until germplasm with more consistent purple flesh, and agronomic performance become available.

Molokai Purple

Molokai Purple

This cultivar has a dark purple skin, with even, dark purple flesh. Its possible origin is Molokai Island, Hawaii.

Industry comments: Growers were enthusiastic about the striking flesh colour, however were very concerned about the unprofitable shape, and low yield low pack out. The also expressed misgivings about the fragility of the sweetpotatoes, and felt the eyes were set too deep.

WSPF

Good points

- Smooth, dark purple skin
- Consistent dark purple flesh

Bad points

- Single skin, so scrapes and abrasions are obvious as the cortex is white
- Low number of roots set per plant that tend to grow long and large
- Prone to constrictions and uneven, bent shape
- Fragile roots, easily broken

Industry rating: 2.5 out of 5.

Experimental performance

	Marketable roots produced (tonnes per hectare)				
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**
WSPF	17.2	10.6	6.3	36.4	19.7
Molokai Purple	7.1	7.4	6.1	10.3*	15.0
% of Standard	41%	70%	97%	28%	76%

Molokai Purple roots have a deep purple skin colour and a consistent purple flesh colour. The purple flesh colour is evenly distributed throughout the flesh. Unfortunately, *Molokai Purple* marketable yields were lower than *WSPF* in Experiment 4, and never above *WSPF* in any other evaluations. Roots exhibit uneven shape, inconsistency in size and many constrictions, bumps and sunken lenticels. Even though the *Molokai Purple,* with such consistency of purple flesh, would fetch higher market prices, this cultivar was not placed into further experiments as industry deemed this cultivar not to be commercially viable, due to low yields. It would be interesting to either understand how to improve the yield and shape performance of *Molokai Purple*, or alternatively transfer the consistency of dark purple flesh across to other germplasm.

Alley's White

Alley's White

This cultivar has a white skin, with white and purple flesh. It was collected by Eric Coleman and William O'Donnell, from Rusty's market in Cairns in 2001.

Good points

- Compact vine, however has good ground cover therefore less weeds
- Smooth shape

WSPF

Bad points

- Shape not consistent
- Highly susceptible to constrictions and shape deformities
- Purple flesh colour not consistent
- Sunken lenticels

Experimental performance

	Marketable roots produced (tonnes per hectare)		
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**
WSPF	17.2	10.6	6.3
Alley's White	15.3	0.6	3.1
% of Standard	89%	6%	49%

Alley's White produced lower yields than *WSPF* and flesh colour was quite variable. *Alley's White* was also prone to constrictions, sunken lenticels and longitudinal grooves. For this reason, *Alley's White* was not included in further evaluations after Experiment 3.

Hawaii Tonga

Hawaii Tonga

This cultivar has a white skin, with variable white and pale purple flesh.

Industry comments: Growers did not like the pale purple flesh, uneven shape, compared to the industry standard *WSPF*.

WSPF

Good points

- Compact vine, however has good ground cover therefore less weeds
- Smooth shape

Bad points

- Shape not consistent
- Highly susceptible to constrictions and shape deformities
- Purple flesh colour not consistent
- Sunken lenticels

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
WSPF	17.2	10.6
Hawaii Tonga	37.2*	5.7
% of Standard	216%	54%

Hawaii Tonga roots were prone to constrictions, longitudinal grooves and uneven shape. *Hawaii Tonga* produced a significantly higher weight of marketable roots than *WSPF* in Experiment 1; however, the amount of colour (purple flesh) was less than was evident in *WSPF* roots in both evaluations. Growers were not interested in pursuing this cultivar because of the poor flesh colour. It was not evaluated further in the project after the first year.

Hawaii V

Hawaii V

This cultivar has a white skin, with variable white and pale purple flesh. It was the commercial cultivar grown in Australia prior to the release of *WSPF*. Many wholesalers still refer to all white-skinned, purple-fleshed sweetpotatoes as 'Hawaiian' sweetpotatoes.

Industry comments: Growers were critical of the lack of purple colour in the flesh.

WSPF

Good points

- Compact vine, however has good ground cover therefore less weeds
- Smooth shape

Bad points

- Shape not consistent
- Highly susceptible to constrictions and shape deformities
- Purple flesh colour often absent

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
WSPF	17.2	10.6
Hawaii V	5.1	4.1
% of Standard	30%	38%

Hawaii V roots were also prone to constrictions, longitudinal grooves and uneven shape. *Hawaii V* produced less marketable sweetpotatoes than *WSPF* in both experiments. Purple flesh colour was often absent in *Hawaii V*. Growers were not interested in pursuing this cultivar because of the poor flesh colour. It was not evaluated further in the project after the first year.

Lola Tonga

Lola Tonga

This cultivar has a dark purple to pink, thin single skin, with white and purple-pink flesh.

Industry comments: Growers did not like the pale purple flesh and uneven shape, compared to the industry standard *WSPF*.

WSPF

Good points

- Dark purple skin colour
- Thought to have some tolerance to drought conditions

Bad points

- Single skin
- Pale purple to pink flesh colour
- Uneven shape prone to longitudinal grooves bumps and constrictions
- Very susceptible to breakdown (bacterial and fungal Infections) in wet soil
- Low root numbers
- Uneven sized roots

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
WSPF	17.2	10.6
Hawaii V	3.9	3.2
% of Standard	22%	30%

Lola Tonga consistently produced lower yields than *WSPF*. *Lola Tonga* roots have a thin single skin that is easily damaged. In experiments with higher than average rainfall, *Lola Tonga* sweetpotatoes were severely affected by breakdown due to bacterial or fungal infections, yielding little to no marketable roots. *Lola Tonga* was not included in any further evaluations after the first year of the project.

White category

Kestle

Kestle

This cultivar has a white skin, with cream to white flesh. It was originally from Taiwan, and selected by Lester Loader named after Ken Jackson, Stuart Scott and Lester Loader. Kestle is the current industry standard White category cultivar in Australia.

Industry comments: Growers noted it is increasingly difficult to sell White category sweetpotatoes, with the main market during the summer harvest.

Good points

- Smooth skin, even shape
- White flesh, not overly sappy

Bad points

- Shape and size can be uneven
- Dark areas on skin under certain conditions
- Yield not consistent
- Roots occasionally set deep, making mechanical harvest difficult

Industry rating: 4 out of 5.

Colleambally

Colleambally

This cultivar has a white skin, with white flesh. It was previously grow commercially in NSW for many years, prior to the introduction of the current industry standard, *Kestle*.

Good points

- Smooth skin, even shape
- White flesh, not overly sappy

Kestle

Bad points

- Shape and size can be uneven
- Dark areas on skin under certain conditions
- Yield not consistent
- Can tend to grow long, with deeply-set roots

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
Colleambally	21.9	11.8
% of Standard	34%	109%

Colleambally has whiter and smoother skin than *Kestle*; however, its lenticels can be larger and more sunken. *Colleambally* was not evaluated in further experiments as it was not different in yield to *Kestle.* It is no longer grown commercially, given *Kestle* replaced it as the White category industry standard. It demonstrates the lack of suitable germplasm in this White category, that no other cultivars were deemed to be better performed than this superseded cultivar.

Whitestar

Whitestar

This cultivar has a white to light tan skin, with white flesh. Eric Coleman imported this cultivar from the USA in 2007.

Industry comments: Growers noted the black surface pitting on the skin, and eyes in this cultivar, which they felt would be unattractive in a packed carton. There were also concerns about the shape and off-white colours.

Kestle

Good points

- Good number of roots set
- White /cream flesh
- Even, straight shape, smooth skin

Bad points

- Very sappy
- Prominent eyes
- Can grow too long and large
- Skin is darker white, often with small areas of black pitting.
- Susceptible to bacterial and fungal infections in wet soil

Industry rating: 3 out of 5.

Experimental performance

	Marketable roots produced (tonnes per hectare)				
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**
Kestle	64.4	10.9	11.6	40.9	22.6
Whitestar US	41.6	9.3	14.9	17.8	15.0
% of Standard	65%	86%	128%	44%	66%

Whitestar produced a similar volume of marketable roots to *Kestle*. Shape was generally long and straight with smooth skin. The slightly darker skin with black surface pitting and cream flesh colour was not appealing to growers. Most industry personnel did not think this cultivar would be worth growing, as it possessed too many undesirable traits.

Sumor

Sumor

This cultivar has a white to light tan skin, with white flesh. Russell McCrystal imported this cultivar from the USA in 2007.

Industry comments: Growers had very mixed opinions about this cultivar. Some were happy with the shape and flesh colour, whilst others were disparaging. All agreed that its sappy exudate on cutting was unappealing.

Kestle

Good points

- Smooth skin, even shape
- High root numbers
- Evenly sized roots
- Tolerance to soil insects

Bad points

- Yield not consistent
- Very sappy
- Cream flesh not as appealing as white flesh
- Tan skin not as appealing as white skin
- When setting a large number of roots, these are slower to mature
- Highly susceptible to bacterial and fungal infections in wet soil

Industry rating: 2.5 out of 5.

Experimental performance

	Marketable roots produced (tonnes per hectare)				
Cultivar	**Exp 1**	**Exp 2**	**Exp 3**	**Exp 4**	**Exp 5**
Kestle	64.4	10.9	11.6	40.9	22.6
Sumor	83.1	14.4	3.3	38.5	24.5
% of Standard	129%	133%	28%	94%	108%

Sumor had nice even shape and smooth skin, however skin and flesh colour were darker than *Kestle*, which growers did not find appealing. *Sumor* produced similar yields to *Kestle*, but was susceptible to bacterial and fungal infections, leading to breakdown at sites with high rainfall over the growing period. When cut *Sumor* produces a large amount of sap. For these reasons, growers and the project team felt *Sumor* was not commercially viable.

Snowhite

Snowhite

Kestle

This cultivar has a clean white skin, with bright, white flesh. It was collected in 2001 at Mango Hill.

Good points

- Smooth skin.
- Crisp, white flesh
- Can be eaten raw
- Early maturing
- High yielding on occasions

Bad points

- Shape uneven and bumpy
- Longitudinal constrictions with sunken lenticels
- Low marketable yield due to shape

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
Snowhite	85.2	0.3
% of Standard	132%	3%

Snowhite consistently produced a high volume of total roots, but a lower volume of marketable roots in Experiment 2. Its flesh is bright white; however, shape is bumpy and bent with longitudinal grooves. *Snowhite* was not evaluated in experiments past the first year of the project, due to irregularity in shape and poor yields. Growers decided that this cultivar would not be commercially viable.

L3

L3

This cultivar has a white skin, with white flesh. It originated in Papua New Guinea.

Industry comments: Growers felt *L3* had a nice white flesh and skin colour; however, the shape was consistently uneven.

Good points

- Smooth, white skin
- White flesh, not overly sappy

Kestle

Bad points

- Shape uneven
- Sunken lenticels
- Longitudinal grooves and constrictions
- Low marketable yield

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
L3	19.6	0.5
% of Standard	30%	4%

Although it had a smooth, white skin and bright, white flesh, *L3* was not evaluated in experiments past the first year of the project, due to irregularity in shape and poor yields. Growers decided that this cultivar would not be commercially viable.

Markham

Markham

This cultivar has a white skin, with white flesh. It originated in Papua New Guinea.

Good points

- Smooth skin, even shape
- White flesh, not overly sappy

Bad points

- Shape and size can be uneven
- Dark areas on skin under certain conditions
- Yield not consistent

Kestle

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
Markham	25.8*	6.7
% of Standard	40%	62%

Markham produced unevenly shaped bendy roots with constrictions and longitudinal grooves. Flesh and skin colour are nice and white, but shape is not desired by industry. *Markham* was not evaluated in experiments past the first year of the project, due to irregularity in shape and poor yields. Growers decided that this cultivar would not be commercially viable.

L49

L49

This cultivar has a white skin, with white flesh. It originated in Papua New Guinea.

Industry comments: Growers felt L49 had a smooth skin with nice white flesh.

Kestle

Good points

- Smooth skin, even shape
- Clean white flesh, not overly sappy

Bad points

- Shape can be uneven
- Large lenticels
- Prone to constrictions, causing bending and longitudinal grooves

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
L49	0.0*	3.7
% of Standard	0%	34%

L49, although having bright white flesh and white smooth skin did not progress through to further experiments, as shape was inconsistent and marketable yields were very low.

Meriken

Meriken

This cultivar was placed into this category incorrectly, as we had only seen it in a pot before, and on that occasion, the flesh was white, with very pale orange in it. In further evaluation, it has a tan skin, and creamy yellow flesh with areas of orange. It originated in Papua New Guinea.

Industry comments: Growers quickly determined this was not a suitable White category cultivar, due to its pale orange flesh, uneven shape and growth cracks.

Kestle

Good points

- Smooth skin

Bad points

- Shape and size can be uneven
- Severe growth cracks and veins
- Yield not consistent
- Pale orange and white flesh

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
Meriken	16.4*	1.0
% of Standard	25%	9%

Meriken sweetpotatoes were uneven in size with veining, constrictions, growth cracks, and dark pitting on the skin surface. *Meriken* was not suited in the White category, as it had an inappropriately orange tinged flesh. It was not evaluated beyond the first year of the project.

L135

L135

This cultivar was placed into this category incorrectly, as we had only seen it in a pot before, and on that occasion, the flesh was white, with very pale orange in it. In further evaluation, it has a tan skin, and creamy yellow flesh with areas of orange. It originated in Papua New Guinea.

Industry comments: Growers quickly determined this was not a suitable White category cultivar, due to its pale orange flesh and uneven shape.

Kestle

Good points

- Smooth skin.

Bad points

- Shape and size can be uneven
- Yield not consistent
- Pale orange and white flesh

Experimental performance

	Marketable roots produced (tonnes per hectare)	
Cultivar	**Exp 1**	**Exp 2**
Kestle	64.4	10.9
L135	13.5*	3.6
% of Standard	21%	33%

L135 produced a lower marketable yield than *Kestle*, and was not suited in the White category, as it had an inappropriately orange tinged flesh. It was not evaluated beyond the first year of the project.

End of project grower survey

In late 2013 and early 2014, the project team surveyed almost 80% of the Australian sweetpotato industry, individually contacting a cross section of small medium and large grower enterprises in New South Wales and Queensland. This grower survey captured current sweetpotato planting portfolios, as well as future intentions for use of the new cultivars evaluated in the project.

Survey results

Production statistics

Area planted

There was a similar area of sweetpotatoes planted in 2012/13, with only a 1.5% increase from the previous year (Fig. 22). Gold cultivar plantings increased by 3%, while plantings of Red category cultivars were relatively constant. Purple cultivars increased by 3.2% between the 2011/12 to 2012/13 financial years. Plantings of White category sweetpotatoes continued to decline during the last two years of the project.

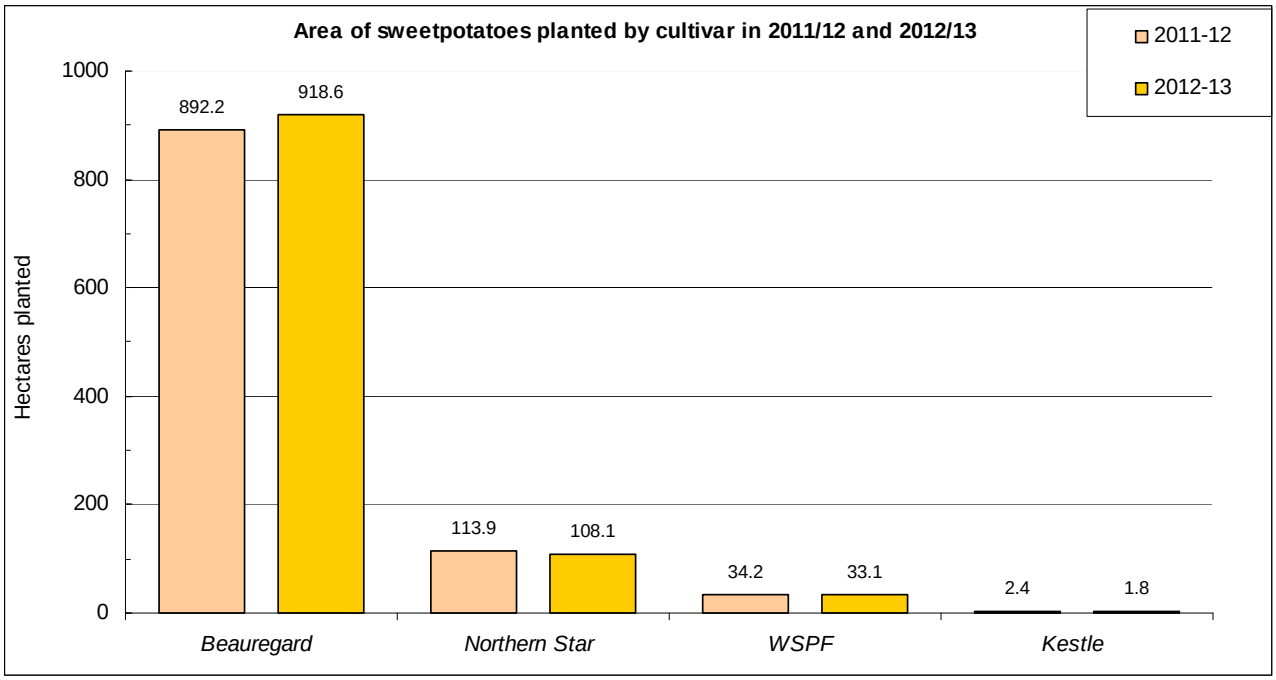


Figure 22 **Areas of Gold, Red, Purple and White sweetpotato planted in QLD and NSW in 2011-2013.**

The penetration of the new cultivars into the commercial mainstream is evident in the Tables 61-63. Although slight, it is an indication that sweetpotato growers are starting to explore potential opportunities with these new cultivars. There is particular interest in the Purple category. The area planted to new cultivars could expand dramatically, as growers bulk up the planting materials in the 2013/14 season.

Table 61 Proportion of Gold sweetpotatoes planted in QLD and NSW in 2009-2013.

		Sweetpotato plantings 2009-2013 (%)			
Sweetpotato category	**Cultivar**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Gold	*Beauregard*	84.2	83.8	81.8	85.5
Gold	*New cultivars*	0.0	0.0	0.0	2.7

Table 62 Proportion of Red sweetpotatoes planted in QLD and NSW in 2009-2013.

		Sweetpotato plantings 2009-2013 (%)			
Sweetpotato category	**Cultivar**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Red	*Northern Star*	16.0	16.5	10.4	10.1
Red	*New cultivars*	0.0	0.0	0.0	0.4

Table 63 Proportion of Purple sweetpotatoes planted in QLD and NSW in 2009-2013.

		Sweetpotato plantings 2009-2013 (%)			
Sweetpotato category	**Cultivar**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Purple	*WSPF*	2.4	2.3	3.8	3.6
Purple	*New cultivars*	0.0	0.0	0.0	0.3

Sweetpotato production

The production values show a relative plateau of sweetpotato volumes marketed, with the exception of a substantial increase in the Red category (Fig. 23). Interestingly, this increased volume came off less planted area, suggesting growers are getting better at growing this category.

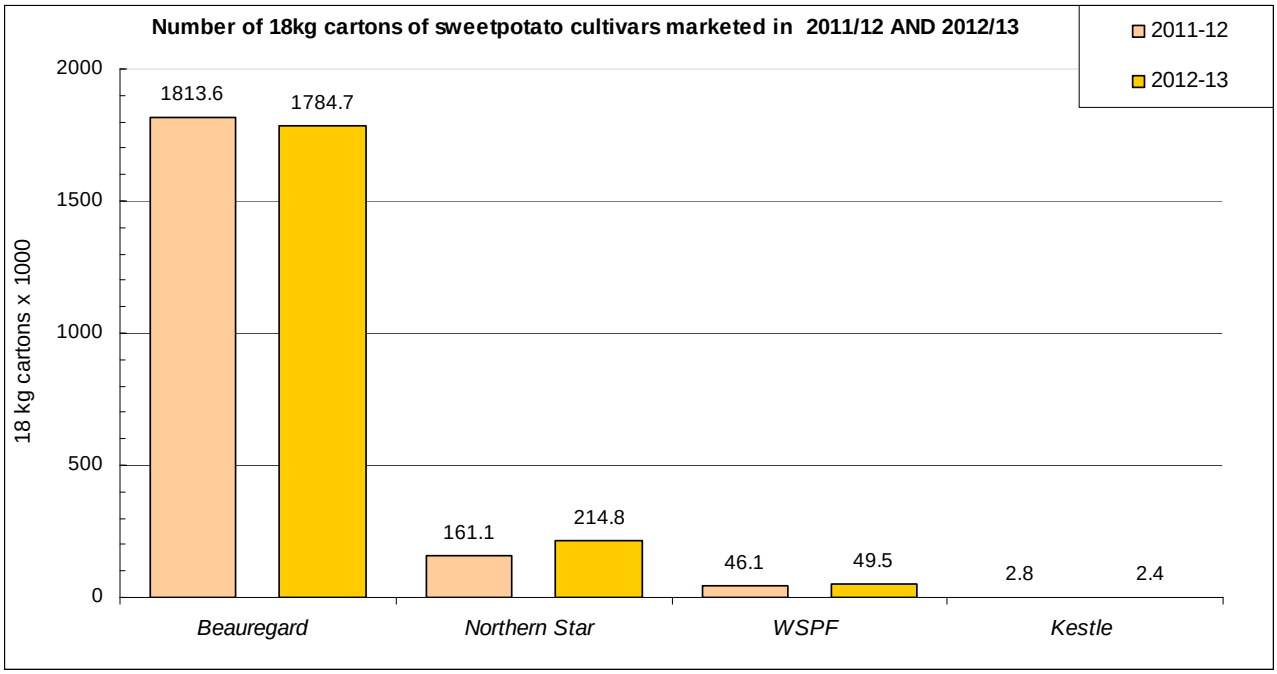


Figure 23 **Volumes of Gold, Red, Purple and White sweetpotato marketed from QLD and NSW in 2011-2013.**

The proportions of new cultivars marketed reflected the areas planted (Tables 64-66).

Table 64 Proportion of Gold sweetpotatoes marketed from QLD and NSW in 2009-2013.

		Sweetpotato cartons marketed 2009-2013 (%)			
Sweetpotato category	**Cultivar**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Gold	*Beauregard*	94.3	92.9	89.6	87.0
Gold	*New cultivars*	0.0	0.0	0.0	3.5

Table 65 Proportion of Red sweetpotatoes marketed from QLD and NSW in 2009-2013.

		Sweetpotato cartons marketed 2009-2013 (%)			
Sweetpotato category	**Cultivar**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Red	*Northern Star*	4.4	6.4	8.0	10.5
Red	*New cultivars*	0.0	0.0	0.0	0.5

Table 66 Proportion of Purple sweetpotatoes marketed from QLD and NSW in 2009-2013.

		Sweetpotato cartons marketed 2009-2013 (%)			
Sweetpotato category	**Cultivar**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Purple	*WSPF*	0.5	0.5	2.3	2.4
Purple	*New cultivars*	0.0	0.0	0.0	0.1

Sweetpotato grower attitudes in 2013

As far as the surveyed growers were concerned in this latest survey, environmental factors were the biggest limitation to production, increasing from 28% in 2009-10 to 50% in 2013. We attribute this to the flooding events experienced in 2011 and 2013.

While only 21% of growers considered pests a major limiting factor in 2013, compared to 24% in 2009, nematodes were the major problem for over 90% of these growers, compared to only 50% of growers expressing major concern with nematodes in 2009. Thus it is probably timely that this project has demonstrated the nematode resistance of several of the new Gold cultivars.

The other major change from the initial survey was the drop in concern about varieties being a substantial impediment to production. Perhaps this project has gone some way to assuring growers that RDE support is doing their best to ensure they are supplied with the best germplasm currently available?

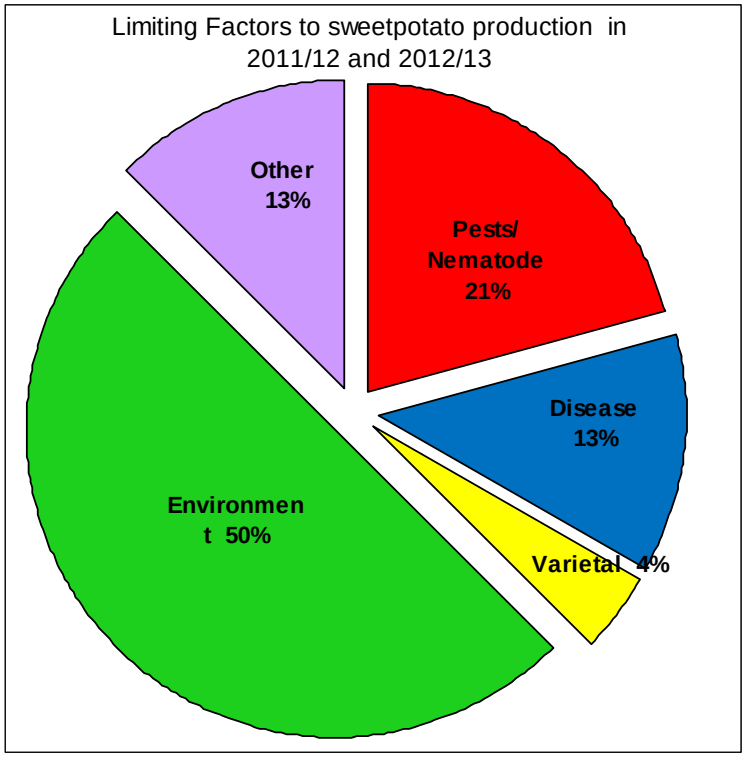


Figure 24 Prioritisation of agronomic issues by sweetpotato growers in QLD and NSW in 2013.

Extension activities

During the project, we conducted a program of ongoing communication and extension activities. Our focus was on interacting with key people in the sweetpotato value chain, including virtually 100% of growers in Queensland and northern New South Wales, as well as their service businesses. We also regularly included wholesalers and end-point retailers in discussions of cultivar performance and development/retention going forward. We described details of the major extension events in the main body of the report.

Our published information output included 14 articles in industry journals and general media, 11 project summaries distributed directly to sweetpotato growers, 5 television broadcasts, 4 radio interviews, and 6 HAL Milestone Reports.

We delivered 8 major industry field days during the course of the project, and were involved in participative project planning with the ASPG technical committee and broader member group at 9 events. These included a major project review midway through the term, and participating in a project tour with Louisiana State University Plant Breeder, Don Labonte.

As well as these group events, we provided substantial individual advice and consultative effort on numerous occasions, to groups as diverse as HAL officers, R&D administrators, parliamentarians, others scientists/researchers/IDOs, and individual producers as part of their day-to-day business.

Project extension will continue as part of our ongoing commitment to vegetable RDE, as well as finalising publishing of various project outputs. We have nearly completed grower fact sheets for each of the cultivars evaluated, which ASPG will send to all Australian sweetpotato growers, as well as lodge on the ASPG website. We will focus on supporting the incorporation of new cultivars in supply chains, as well as developing ongoing projects to partner industry RDE efforts.

Extension activities

Publications

Press

Glasser R (2011). Producers show off Queensland delights. In 'Queensland Country Life' 14/04/11, pp 79 and 82.

Anon (2011). Sweet as! Scientists give spuds a colourful makeover. In 'Queensland Times' 20/04/11, pp 17.

Anon (2011). Qld sweet potatoes gain new flavour. In 'Queensland Country Life' 21/04/11, pp 88.

Anon (2011). Sweet science. In 'Tablelands Advertiser' 22/04/11, pp 17.

Anon (2011). Spud brother. In 'Courier Mail' 23/04/11, pp 32.

Anon (2011). Sweet colours in the kitchen. In 'Cooloola Advertiser' 26/04/11, pp 8.

Anon (2011). Sweet makeover for the humble potato. In 'Gladstone Observer' 28/04/11, pp 21.

Anon (2011). The science of sweet potato. In 'Clifton Courier' 27/04/11, pp 7.

Anon (2011). Sweet makeover for the humble potato. In 'Queensland Times' 28/04/11, pp 19.

Anon (2011). Humble vegie gets a makeover. In 'Gympie Times' 05/05/11, pp 17.

Anon (2011). What's behind the humble sweet potato. In 'Whitsunday Guardian' 11/05/11, pp 13.

Wolfenden R (2011). VG09009 summary for HAL Annual Vegetable Report. In 'HAL Vegetable Industry Report 10-11', p 4.

Wolfenden R (2012). VG09009 summary for HAL Annual Vegetable Report. In 'HAL Vegetable Industry Report 11-12', p 5.

Wolfenden R (2013). VG09009 summary for HAL Annual Vegetable Report. In 'HAL Vegetable Industry Report 12-13', p 7.

Industry distribution

Dennien S (2011). Experimental summary – Bundaberg first stage cultivar evaluation experiment 2011. Distributed to ASPG members and associated businesses.

Dennien S (2011). Experimental summary – Cudgen cultivar evaluation experiment 2011. Distributed to ASPG members and associated businesses.

Dennien S (2012). Experimental summary – Bundaberg cultivar evaluation Moore Park Road Experiment 2012. Distributed to ASPG members and associated businesses.

Dennien S (2012). Experimental summary – Bundaberg cultivar evaluation Rubyanna Road Experiment 2012. Distributed to ASPG members and associated businesses.

Dennien S (2012). Experimental summary – Cudgen cultivar evaluation Reardon's Road Experiment 2012. Distributed to ASPG members and associated businesses.

Dennien S (2013). Experimental summary – Cudgen cultivar evaluation Cudgen Road Experiment 2013. Distributed to ASPG members and associated businesses.

Dennien S (2013). Experimental summary – Bundaberg cultivar evaluation Windemere Road Experiment 2013. Distributed to ASPG members and associated businesses.

Dennien S (2013). Experimental summary – Cudgen cultivar evaluation Tweed Coast Road Experiment 2013. Distributed to ASPG members and associated businesses.

Dennien S (2013). Experimental summary – Bundaberg cultivar evaluation Lindeman's Road Experiment 2013. Distributed to ASPG members and associated businesses.

Dennien S (2013). Experimental summary – Cudgen cultivar evaluation Reardon's Road Experiment 2013. Distributed to ASPG members and associated businesses.

Dennien S (2013). Experimental summary – Bundaberg cultivar evaluation Gin Gin Road Experiment 2013. Distributed to ASPG members and associated businesses.

Group presentations

Field days

Cudgen Sweetpotato Field Day, 2 Dec 2010. Discussed project concepts and plans with Cudgen growers and service industry personnel.

Bundaberg Sweetpotato Field Day, 12 Jul 2011. Visited experimental sites, discussed project initial activities and cultivar impressions with Bundaberg growers and service industry personnel.

Cudgen Sweetpotato Field Day, 16 Nov 2011. Visited experimental sites, discussed project activities and cultivar evaluations with sweetpotato growers and service industry personnel. Taste tested cultivars, and preliminary consolidation of project cultivar portfolio.

Bundaberg Sweetpotato Field Day, Moore Park Road, 27 Apr 2012. Visited experimental sites, discussed project activities and cultivar evaluations with sweetpotato growers and service industry personnel.

Cudgen Sweetpotato Field Day, 24 Aug 2012. Visited experimental sites, discussed project activities and cultivar evaluations with sweetpotato growers and service industry personnel.

Bundaberg Sweetpotato Field Day, Rubyanna Road, 18 Sep 2012. Visited experimental sites, discussed project activities and cultivar evaluations with sweetpotato growers and service industry personnel.

Cudgen Sweetpotato Field Day, 14 May 2013. Visited experimental sites, discussed project activities and cultivar evaluations with sweetpotato growers and service industry personnel.

Bundaberg Sweetpotato Field Day and Bus Tour, 12 Jun 2013. Visited experimental sites, discussed project activities and cultivar evaluations with sweetpotato growers and service industry personnel.

ASPG meeting presentations and reviews

Bundaberg 5 May 2010: initial project planning and implemntation.

Bundaberg 29 Oct 2010: project update and review presentation

Bundaberg 25 Aug 2011: project update and review presentation

Cudgen 16 Nov 2011: project update and review presentation

Major independent project review 1 March 2012: Independent project review by Dr Grahame Jackson

Bundaberg 27 Apr 2012: project update and review presentation

Industry tour May 2012: tour of project sites and visits to industry stakeholders, with Louisiana State University sweetpotato breeder, Professor Don Labonte.

ASPG project report 30 Jun 2013: project update and review presentation

ASPG project report 30 Sep 2013: project update and review presentation

Experimental/demonstrations

Dennien S (2011). Conducted detailed cultivar evaluation in collaboration with Troy Prichard, Rosedale Road, Bundaberg, January-September 2011.

Dennien S (2011). Conducted detailed cultivar evaluation in collaboration with Paddon family, Reardon's Road, Cudgen, February-November 2011.

Dennien S (2012). Conducted detailed cultivar evaluation in collaboration with Duane Joyce, Moore Park Road, Bundaberg, November 2011-April 2012.

Dennien S (2012). Conducted detailed cultivar evaluation in collaboration with Kennedy family, Reardon's Road, Cudgen, December 2011-July 2012.

Dennien S (2012). Conducted cooperative grower cultivar evaluation in collaboration with Eugenio Mizzi, Lindeman's Road, Bundaberg, December 2011-May 2012.

Dennien S (2012). Conducted cooperative grower cultivar evaluation in collaboration with Reid Tucker, Lindeman's Road, Bundaberg, December 2011-May 2012.

Dennien S (2012). Conducted detailed cultivar evaluation in collaboration with Dave Holt, Moore Park Road, Bundaberg, February-September 2012.

Dennien S (2012). Conducted cooperative grower cultivar evaluation in collaboration with Sam Tully, Reardon's Road, Cudgen, January-September 2012.

Dennien S (2012). Conducted cooperative grower cultivar evaluation in collaboration with Rodney Woldenden, Rossmoya, February-June 2012.

Dennien S (2012). Conducted cooperative grower cultivar evaluation in collaboration with Darren Zunker, Windemere Road, Bundaberg, February-September 2012.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Matthew Prichard, Cudgen Road, Cudgen, November 2012-May 2013.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Ken Small, Tweed Coast Road, Cudgen, November 2012-April 2013.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Eugenio Mizzi, Lindeman's Road,, Bundaberg, November 2012-not harvested.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Reid Tucker, Lindeman's Road, Bundaberg, November 2012-July 2013.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Sam Tully, Reardon's Road, Cudgen, November 2012-May 2013.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Darren Zunker, Windemere Road, Bundaberg, December 2012-June 2013.

Dennien S (2013). Conducted detailed cultivar evaluation in collaboration with Peterson family, Gin Gin Road, Bundaberg, December 2012-June 2013.

Dennien S (2013). Conducted cooperative grower cultivar evaluation in collaboration with Troy Prichard, Elliot Heads Road, Bundaberg, January-Setember 2013.

Dennien S (2013). Conducted cooperative grower cultivar evaluation in collaboration with Rodney Woldenden, Rossmoya, June 2013-January 2014.

Dennien S (2013). Conducted cooperative grower cultivar evaluation in collaboration with Ashley Zelinski, Lake Clarendon, February-August 2013.

Dennien S (2013). Conducted cooperative grower cultivar evaluation in collaboration with Ernie Jowatt, Elliot Heads Road, Bundaberg, Setember 2013- January 2014.

HAL milestone reports

Wolfenden R (2010) 'HAL Project VG09009 Milestone Report 102.' Horticulture Australia Ltd, Sydney, Australia. Milestone report November 2010.

Wolfenden R (2011) 'HAL Project VG09009 Milestone Report 104.' Horticulture Australia Ltd, Sydney, Australia. Milestone report May 2011.

Wolfenden R (2011) 'HAL Project VG09009 Milestone Report 105.' Horticulture Australia Ltd, Sydney, Australia. Milestone report November 2011.

Wolfenden R (2012) 'HAL Project VG09009 Milestone Report 106.' Horticulture Australia Ltd, Sydney, Australia. Milestone report May 2012.

Wolfenden R (2012) 'HAL Project VG09009 Milestone Report 107.' Horticulture Australia Ltd, Sydney, Australia. Milestone report November 2012.

Wolfenden R (2013) 'HAL Project VG09009 Milestone Report 108.' Horticulture Australia Ltd, Sydney, Australia. Milestone report May 2013.

Television and radio

Television

Broadcast Seven Bundaberg (Bundaberg), Seven Local News 20 April 2011: 6:13 PM, *Rob Brough*: Interviewees: Russell McCrystal, Agri-Science Qld; Troy Prichard, Farmer.

Broadcast Seven Mackay (Mackay), Seven Local News 21 April 2011: 6:10 PM, *Rob Brough*: Interviewees: Russell McCrystal, Agri-Science Qld; Troy Prichard, Farmer.

Broadcast Seven Rockhampton (Rockhampton), Seven Local News 21 April 2011: 6:11 PM, *Rob Brough and Joanne Desmond*: Interviewees: Russell McCrystal, Agri-Science Qld; Troy Prichard, Farmer.

Broadcast Seven Cairns (Cairns), Seven Local News 26 April 2011: 6:13 PM, *Rob Brough and Joanne Desmond*: Interviewees: Russell McCrystal, Agri-Science Qld; Troy Prichard, Farmer.

Broadcast Seven Townsville (Townsville), Seven Local News 26 April 2011: 6:17 PM, *Kay McGrath and Rod Young*: Interviewees: Russell McCrystal, Agri-Science Qld; Troy Prichard, Farmer.

Radio

Broadcast ABC Wide Bay (Bundaberg), Rural Report 20 April 2011: 6:20 AM, *Scott Lamond*: Interviewees: Russell McCrystal, Agri-Science Qld.

Broadcast ABC Wide Bay (Bundaberg), 06:30 News 20 April 2011: 6:32 AM, *Brian Pearce*: Interviewees: Russell McCrystal, Agri-Science Qld.

Broadcast ABC Southern Queensland (Toowoomba), Qld Country Hour 20 April 2011: 12:49 PM, *Jane Paterson*: Interviewees: Russell McCrystal, Agri-Science Qld.

Broadcast 4GR (Toowoomba), Focus on the Downs 12 May 2011: 12:31 PM, *Graham Healy*: Interviewees: Russell McCrystal, Agri-Science Qld.

Project recommendations

Supply of pathogen tested planting material

A major undertaking in this project was bulking up planting material for evaluation. During the term of this project, the company Aus Sweetpotato Seed in Rockhampton, which supplies virtually all the PT planting material for the Australian sweetpotato industry, has substantially increased capability. The project team now believes that company has the capacity to provide germplasm multiplication services to sweetpotato RDE projects. This would obviously need sufficient notice of cultivars required, and funding commensurate with the size of the order. In the proposed system, Aus Sweetpotato Seed would supply roots for planting beds, which could be used to generate planting material for the intended experiments. This system would only apply where the company are confident they have suitable PT mother stock.

The Australian sweetpotato industry requires an ongoing capacity to test new germplasm for virus and similar diseases, identify any organisms present, and ideally, to effectively clean stocks of diseases. The same system is required to maintain the integrity of current germplasm, both library and commercial collections. In the short term, this capacity may be addressed *ad hoc* in contracted sweetpotato projects. However, the industry will need to develop a commercial capacity to service this requirement, as there are currently limited people with the necessary skills within the Australian RDE sector. Of concern is the dependence of those skilled personnel on short-term project funding and employment opportunities to maintain this capacity.

Identifying new germplasm

In this project, we identified a broad sweep of sweetpotato cultivars for evaluation. These cultivars had been collected previously by either growers or research staff in the last few decades, as they conducted other activities. Alternatively, new germplasm were extracted from past sweetpotato collections, or had been recently imported by scientists or commercial personnel.

The curation and maintenance of PT germplasm through tissue culture and mother plant collections at Aus Sweetpotato Seed in Rockhampton, and DAFFQ Gatton Research Facility, has been a major project outcome.

Within the Australian sweetpotato industry, there are several stakeholders who are commercially importing cultivars. The cost and time frame of introducing new germplasm to Australia has increased markedly in the past few years. It is probably no longer viable to expect short-term research projects to fulfil this role. Our project team suggests there is a need to review how the sweetpotato industry will identify new germplasm in the future, and clearly develop an industry plan.

Although the project has identified new cultivars suitable for innovation into the Australian sweetpotato industry, there is still a need to look out for:

- A red-skin, white-fleshed cultivar with smooth shape, good root numbers and consistent size
- A smooth-skinned, higher yielding sweetpotato cultivar with consistent purple flesh
- A high yielding, ‘backup’ gold-fleshed cultivar with different pest resistance profile and background to Beauregard

Assessing the performance and potential of new sweetpotato cultivars

Preliminary storage root quality assessment

In our project, cleaning plant material, bulking up PT roots and cuttings, and then conducting detailed performance assessments, was very time and resource hungry. During the course of the project, we discovered that most growers and industry personnel were particularly concerned about sweetpotato quality parameters, such as root shape, size, skin and flesh colour and condition. Rather than shift straight into detailed field evaluations, the sweetpotato industry should explore an innovative way to obtain that root quality data first.

One suggestion may be a standardised facility with large growing containers, where representative soils can be used to generate sweetpotato storage roots under idealised growing conditions. If a cultivar fails to provide marketable roots in a best-bet environment, then it could be given lower priority for ongoing evaluation.

Detailed experimental evaluation

Many of the detailed experiments with grower collaborators had very high variability between plots and reps. This is inherent with sweetpotato, and perhaps more so with some of the new cultivars. There is always the issue that it is difficult to manage all the inputs in a commercial grower field, given producer imperatives to manage their crops to generate maximum return for their enterprise. The project reminds us that sufficient time and resources need to be devoted to grower liaison and support for work conducted at non-research facilities, particularly those at a distance from key researchers’ places of employment.

Whilst the project team made every endeavour to ensure uniform planting material, it is likely that the plots would always still be inherently variable. A key learning is the need to increase the area of plots sampled, and possibly the number of plot replicates. This would require increased expenditure on resources and labour per experiment, as well as additional support to growers who are providing a more extensive land area within their commercial operation. The design of project experimentation needs to take these increased intensity requirements into account.

Grower-scaled evaluation

Small areas of new cultivar plantings can give growers a reasonable idea of what the sweetpotato storage roots look like. Our project suggests they are less effective at generating yield and marketability performance data for growers.

A key recommendation of this project is that grower evaluations be designed with sufficiently large-scale plantings that they can commercially harvest the new cultivars, and put them through their packing sheds in their normal operation. RDE personnel can assist with the design, implementation and analysis of these evaluations, so that growers can get the most from their efforts. This scale of evaluation is probably most important when attempting to innovate a new cultivar into a sweetpotato market chain.

Agronomy and market development of new cultivars

Both *Evangeline* and *Bienville* had positive attributes that make them attractive to consumers and growers. Their nematode resistance, and perhaps some tolerance to soil insects, are useful characteristics, helping growers reduce input costs and environmental impacts. Both cultivars also have attractive root shapes and size grades, delivering sweetpotatoes in the small-medium, premium size grades.

However, there is a concern (major, in the case of *Bienville*), about the sweetpotatoes splitting under certain growing and harvesting conditions. Preliminary thoughts are that the splitting may be worse where rapid growth follows a slow growth period; say for the Spring-harvest crop, grown through Winter. It may also be worse in high fertility conditions. *Bienville* is certainly more prone to cracking than *Evangeline*, but it is a risk with both cultivars.

At their best, both cultivars have a rose-gold colour skin, which is quite attractive to consumers. However, there have been recent reports where *Evangeline* has been rejected in the market place, because the skin has gone more purple-gold, and is confused with Red category sweetpotatoes. This has appeared to be more common with cool season harvests, again in the early Spring period.

Lastly, in situations where nematodes and soil insects are not a problem, the yields of *Evangeline* and *Bienville* appeared not as good as *Beauregard*. Both new cultivars seem to set sufficient storage roots; it is their conversion to marketable sweetpotatoes that seems problematic.

The project team suggests targeted agronomic studies are needed to understand and reduce the risks of splitting and off-colours in these cultivars, and perhaps develop ways of overcoming those issues. Similarly, agronomic studies would be helpful to maximise the yield/pack-out for *Evangeline* and *Bienville*; they may require different density, fertiliser and maturation strategies to *Beauregard*.

Southern Star seems the most promising Red cultivar. Similar to above, there may be substantial benefits to honing the agronomic practices for producing *Southern Star*. Issues are avoiding bronze colouring of the skin, as well as preventing the sweetpotatoes growing too large.

Both *Philipino White* and *Eclipse* are promising Purple cultivars. They still have problems with uneven shape and unpredictable flesh colour, however are no worse than the industry standard in this respect. As above, there is certainly scope to improve their performance with agronomic study.

Because of the lack of suitable germplasm, and a deteriorating market for White sweetpotatoes, there does not seem much point in further investing in this category at this time. An exception may be where an outstanding cultivar is found, and a niche market, e.g. for low GI products, is targeted.

The project team suggests that a collaborative market chain, agronomic development approach would be the best way to innovate any new cultivars into the sweetpotato industry. Given the current dominance of *Beauregard* and the Gold category, consumers and the market have relatively rigid expectations of what a ‘sweetpotato’ is. Introducing new cultivars into this environment will require more than just successfully growing the sweetpotato. Industry should also invest focus and effort into developing awareness and marketing plans around the new cultivars, particularly if they have different attributes to the current industry standards.

Collaborative research

The project team felt the close engagement between scientists, growers, and support industries during the project was a particular strength. Having the overarching presence of ASPG and their R&D people oversighting and reviewing the project on a regular basis was very helpful. It continued to build the two-way relationship between researchers and adopters, meaning the work went in a direction that industry wanted, and they took ownership of both the process and the results. It made the extension process so much easier. Because the R&D was being done in an industry environment, they were seeking the information, and providing invaluable feedback.

The project team very strongly recommends this immersion of RDE in the target vegetable industry as the best way to achieve practice change. It is very important that this style of RDE activity continue, to maintain the mutual relationship and development of capacity in the industry and research sectors.

References

Coleman E, Maltby J, McCrystal R, O'Donnell W and Playford C (2006). *Developing smooth skin, easy to peel sweetpotatoes.* Horticulture Australia Final Report No. VG02114. Horticulture Australia Ltd, Sydney, Australia.

Dennien S, Homare D, Hughes M, Lovatt J, Coleman E and Jackson G. (2013). *Growing healthy sweetpotato: best practices for producing planting material.* ACIAR Monograph No. 153. Australian Centre for International Research, Canberra, Australia.

Gething K, Henderson CWL, McIntryre A and Dennien S (2012). *Sweetpotato consumer research: insights to increasing consumption.* Technical Report 3572. Queensland Government, Brisbane, Australia. era.deedi.qld.gov.au/3572/