

# Horticulture impact assessment program 2020-21 to 2022-23 (MT21015)

*Annex 11: Impact assessment of the project **Investigation of skin hardening and splitting disorders in sweetpotato (PW18001)***

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## Executive summary

### What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in *PW18001 Investigation of skin hardening and splitting disorders in sweetpotato*. The project was funded by Hort Innovation over the period April 2019 to November 2020.

### Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 2020-21 dollar terms and were discounted to the year 2020-21 using a real (inflation-adjusted), risk free, pre-tax discount rate of 5% to estimate the investment criteria and a 5% reinvestment rate to estimate the modified internal rate of return (MIRR).

### Results/key findings

This research project was conducted by the Department of Agriculture and Fisheries (DAF) and partnered with the Louisiana State University AgCenter to investigate links between key nutrients and skin hardening and splitting. Currently some sweetpotato cultivars are prone to splitting at harvest with reported farm losses of 10-30% and other cultivars are prone to skinning damage, an issue that is likely to become more prevalent as more single skin varieties enter the commercial market.

The Hort Innovation investment in Project PW18001 was successful in its objective to contribute increased knowledge and understanding of skin hardening and splitting disorders in sweet potatoes. While the project was unable to confirm a cause of the disorders, this pilot study has narrowed the search for their cause, and recommendations have been included to aid future research priorities.

Not all of the identified impacts could be valued in the assessment, particularly where there was a lack of credible data. These additional economic, social and environmental impacts have the potential to provide additional industry impact above what has been identified.

### Investment criteria

Total funding from all sources for the project was \$0.29 million (2020-21 equivalent value) with Hort innovation being the only Australian investor in the project.

The identified impacts were not able to be valued in monetary terms and so a full set of investment criteria were not reported as part of this impact assessment.

### Conclusions

Although no project impacts were able to be valued this pilot project was successful in its objectives, particularly that of building knowledge and research capability. PW18001 set objectives for a phase 2 project which commenced in 2020-21 (PW21002: *Causes and management strategies for skin loss in sweet potato*). Any potential outcomes of phase two will be partly attributable to the foundational work completed in PW18001; however, at the time of this analysis the economic impact was not able to be quantified given the uncertainties of research outputs and outcomes.

### Keywords

Impact assessment, cost-benefit analysis, sweetpotato, skinning, splitting

## Introduction

Evaluating the impacts of levy investments is important to demonstrate to levy payers, Government and other industry stakeholders the economic, social and environmental outcomes of investment for industry, as well as being an important step to inform the ongoing investment agenda.

The importance of ex-post evaluation was recognised through the Horticulture Innovation Australia Limited (Hort Innovation) independent review of performance completed in 2017, and was incorporated into the Organisational Evaluation Framework.

Reflecting its commitment to continuous improvement in the delivery of levy funded research, development and extension (RD&E), Hort Innovation required a series of impact assessments to be carried out annually on a representative sample of investments of its RD&E portfolio. The assessments were required to meet the following Hort Innovation evaluation reporting requirements:

- Reporting against the Hort Innovation's Strategic Plan and the Evaluation Framework associated with Hort Innovation's Statutory Funding Agreement with the Commonwealth Government.
- Reporting against strategic priorities set out in the Strategic Investment Plan for each Hort Innovation industry fund.
- Annual Reporting to Hort Innovation stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

As part of its commitment to meeting these reporting requirements, Ag Econ was commissioned to deliver the *Horticulture Impact Assessment Program 2020-21 to 2022-23* (MT21015). This program consisted of an annual impact assessment of 15 randomly selected Hort Innovation RD&E investments (projects) each year.

Project *PW18001 Investigation of skin hardening and splitting disorders in sweetpotato* was randomly selected as one of the 15 investments in the 2020-21 sample. This report presents the analysis and findings of the project impact assessment.

## General method

The 2020-21 population was defined as an RD&E investment where a final deliverable had been submitted in the 2020-21 financial year. This generated an initial population of 175 Hort Innovation investments, worth an estimated \$101.14 million (nominal Hort Innovation investment). The population was then stratified according to the Hort Innovation RD&E research portfolios and five, pre-defined project size classes. Projects in the Frontiers Fund, and those of less than \$80,000 Hort Innovation investment being removed from the sample. From the remaining eligible population of 59 projects, with a combined value of \$39.51 million, a random sample of 15 projects was selected worth a total of \$9.7 million (nominal Hort Innovation investment), equal to 25% of the eligible RD&E population (in nominal terms).

The impact assessment followed general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach included both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved reviewing project contracts, milestones, and other documents; interviewing relevant Hort Innovation staff, project delivery partners, and growers and other industry stakeholders where appropriate; and collating additional industry and economic data where necessary. Through this process, the project activities, outputs, outcomes, and impacts were identified and briefly described; and the principal economic, environmental, and social impacts were summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were valued in monetary terms. Where impact valuation was exercised, the impact assessment uses cost-benefit analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

## Background and rationale

### Industry background

In Australia, the sweetpotato industry had a production value of \$91.5 million in 2020-21 (Hort Innovation 2022a), with

consumer satisfaction directly related to a high-quality consistent product of uniform appearance and taste. Recent years have seen an increase in the introduction of higher performing varieties developed in the United States of America (USA) as well as a change from seasonal to year-round production (QDAF 2021).

Producers in the sweetpotato industry pay levies to the Department of Agriculture, Fisheries and Forestry (DAFF), which is responsible for the collection, administration and disbursement of levies and charges on behalf of Australian agricultural industries. A Levy is payable on sweetpotato that are produced in Australia and either sold by the producer or used by the producer in the production of other goods. Hort Innovation manages the sweetpotato levy funds which are directed to R&D and marketing.

## Rationale

The research and development activities of the sweetpotato industry are guided by the industry’s Strategic Investment Plan (SIP). The Sweetpotato SIP 2017-21 (under which PW18001 was delivered) was managed by Hort Innovation in consultation with Australian sweetpotato levy payers and represents the Australian sweetpotato industry’s collective view of its R&D and marketing needs from 2017 to 2021.

With the introduction of higher performing USA-developed varieties as well as a change from seasonal to year-round production, farmers have identified an increase in storage root splitting which is reducing marketable yields. On-farm splitting rates of 10-30% have been observed, during cooler weather harvests. Bellevue which now constitutes 80% of the current Australian sweetpotato market is particularly susceptible to splitting.

A second, long standing issue affecting sweetpotato marketability is that of skinning damage during harvest and post-harvest operations. This leads to the development of unsightly, sunken and later darkened areas on the skin surface. Several varieties are prone to this damage and the issue is becoming more important with new USA-bred single skin varieties entering the market.

In general, very little is known about the causes of storage root splitting or why some varieties are more prone to skinning. Other than prior evidence linking boron deficiency with skin blister, there is no current data available on specific causes of sweetpotato splitting or skinning.

Investment in PW18001 sought to build a better understanding of these two prevalent issues.

## Alignment with the Sweetpotato Strategic Investment Plan 2017-2021

The Sweetpotato SIP 2017-21 identified four desired outcomes and Project PW18001 primarily addresses one of these being Outcome 2: *By 2021, the Australian sweetpotato industry has increased marketable yield per hectare through adoption of technology, management best practice and cultivars.*

## Alignment with national priorities

The Australian Government’s National RD&E priorities (2015a) and Science and Research Priorities (2015b) are reproduced in Table 1. The project outcomes and related impacts will contribute to RD&E Priority 1, and to Science and Research Priority 1.

**Table 1. National Agricultural Innovation Priorities and Science and Research Priorities**

Australian Government	
National RD&E Priorities (2015a)	Science and Research Priorities (2015b)
<ol style="list-style-type: none"> <li>1. Advanced technology</li> <li>2. Biosecurity</li> <li>3. Soil, water and managing natural resources</li> <li>4. Adoption of R&amp;D.</li> </ol>	<ol style="list-style-type: none"> <li>1. Food</li> <li>2. Soil and Water</li> <li>3. Transport</li> <li>4. Cybersecurity</li> <li>5. Energy and Resources</li> <li>6. Manufacturing</li> <li>7. Environmental Change</li> <li>8. Health.</li> </ol>

## Project details

### Summary

Table 2. Project details

<b>Project code</b>	PW18001
<b>Title</b>	<i>Investigation of skin hardening and splitting disorders in sweetpotato</i>
<b>Research organization</b>	Queensland Department of Agriculture & Fisheries (DAF)
<b>Project leader</b>	Sandra Dennien
<b>Funding period</b>	April 2019 to November 2020

### Logical framework

A logical framework is shown in Table 3 to highlight the connection between the project activities, outputs, outcomes, and impact.

Table 3. Project logical framework

Activities	<ul style="list-style-type: none"> <li>• Queensland experiments: Preliminary glasshouse studies were undertaken in Australia at the DAF Bundaberg Research Facility,</li> <li>• Experiments were designed to investigate any individual effects of boron and calcium on splitting and skinning.</li> <li>• Louisiana experiments: completed in conjunction with the Louisiana State University (LSU) AgCenter physiologist Professor Arthur Villordon</li> <li>• Exposure to simulated and natural low temperature and splitting.</li> <li>• Ammonium vs. nitrate effects on storage root splitting</li> <li>• Direction and support provided by a Project Reference Group (PRG) made up of sweetpotato growers from the Australian Sweetpotato Growers Association Inc.</li> <li>• Monitoring and evaluation</li> <li>• Stakeholder engagement</li> <li>• Developed hydraulic periderm removal tool for quantification of skinning susceptibility in sweetpotato.</li> </ul>
Outputs	<ul style="list-style-type: none"> <li>• Six monthly milestone reports (two).</li> <li>• Positive collaboration and communication between Australian and USA project staff led to successful trial implementation.</li> <li>• Trial results documented and communicated to industry both as reports and presentations at grower/industry meetings, in Bundaberg and Cudgen. In 2020, farmer group workshops, the preferred communication format were unable to be conducted so webinars were used as an alternative delivery method.</li> <li>• Final report to inform industry of direction for future research and development to address skinning and splitting issues.</li> <li>• Communication and Extension activities</li> <li>• Report produced on initial results in Queensland.</li> <li>• Report produced on initial results in Louisiana.</li> <li>• Report produced on Prof. Villordon Australian visit, November 2019.</li> </ul>
Outcomes	<ul style="list-style-type: none"> <li>• It was not expected that project findings would lead to immediate on farm adoption. Rather, this pilot study provided an insight into the complexities of nutritional and variety relationships between skin hardening, that influences splitting and skinning in Australia's main sweetpotato varieties.</li> <li>• The Australian industry has new understanding of the interactions and physiological attributes between individual varieties and nutrients, both those bred in the USA and of Australian origin and their adaptability to the expanded year-round Australian production system.</li> <li>• Improved understanding of nutritional and climatic interactions in sweetpotato root development in pot trials. This has identified pathways for future research to reduce yield losses.</li> </ul>

	<ul style="list-style-type: none"> <li>• Mutually beneficial international collaborative partnerships established to overcome sweetpotato production issues (skinning and splitting).</li> <li>• Australian researchers have gained increased knowledge, skills and experience through collaboration with overseas sweetpotato experts.</li> <li>• Overseas experts have increased knowledge and experience on specific variety performance under year-round Australian growing conditions. This has enhanced research capability to benefit Australian growers</li> </ul>
Impacts	<ul style="list-style-type: none"> <li>• [Economic] As this was a pilot study no economic impacts were identified.</li> <li>• [Social] Collaboration with the LSU AgCenter contributing to research capacity and information sharing.</li> <li>• [Social] Increased Knowledge and capacity of the disorders providing a foundation for future research to build upon from a better understanding of its incidence, spread, and economic impact. A phase 2 trial which commenced in 2020-21 (PW21002: <i>Causes and management strategies for skin loss in sweet potato</i>).</li> <li>• [Economic] Any potential outcomes of phase two will be partly attributable to the foundational work completed in PW18001; however, at this time the economic impact is not able to be quantified given the uncertainties of research outputs, and outcomes.</li> </ul>

## Project costs

### Nominal investment

Table 4. Project nominal investment

Year end 30 June	Hort Innovation (\$)	DAF, LSU, & Grower PRG(\$)	Total
2018	\$0	\$0	\$0
2019	\$19,975	\$31,068	\$51,043
2020	\$59,924	\$90,734	\$150,658
2021	\$19,975	\$29,846	\$49,821
Total	\$99,874	\$151,648	\$251,522

### Program management costs

Total R&D costs also include the administrative and overhead costs associated with managing and supporting the project. The Hort Innovation overhead and administrative costs were calculated for each project funding year based on the data presented in the *Statement of Comprehensive Income* in the *Hort Innovation Annual Report* for the relevant year. Where the overhead and administrative costs were equal to the total expenses, less the research and development and marketing expenses. The overhead and administrative costs were then calculated as a proportion of combined project expenses (RD&E and marketing), averaging 15.70% for the PW18001 funding period (2019-2021). This figure was then applied to the nominal Hort Innovation investment shown in Table 4.

### Real Investment costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2020-21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2022).

### Extension costs

There were no additional costs associated with PW18001 for project extension. Results were communicated to other researchers as part of the project.

## Project impacts

### Impacts valued

Due to being a pilot study the investment in PW18001 was not found to produce any direct quantifiable impacts to be valued and so no quantitative evaluation process has been applied.

## Impacts not valued

The following impacts were not valued.

- [Social] Collaboration with the LSU AgCenter contributing to research capacity and information sharing.
- [Social] Increased knowledge and capacity of the disorders providing a foundation for future research to build upon from a better understanding of its incidence, spread, and economic impact. A phase 2 project commenced in 2020-21 (PW21002 *Causes and management strategies for skin loss in sweet potato*).
- [Economic] Any potential outcomes of phase two will be partly attributable to the foundational work completed in PW18001; however, at this time the economic impact is not able to be quantified given the uncertainties of research outputs, and outcomes.

## Public versus private impacts

The impacts identified from the investment in PW18001 are predominantly public in nature in the form of capacity built in the research sector.

## Distribution of private impacts

Private economic benefits are anticipated to be captured by individual sweetpotato growers and supply chain participants in the event that further research is undertaken on skin hardening and splitting disorders leading to management strategies and improved disease management. The total private impacts will be redistributed between growers and supply chain participants depending on both short- and long-term supply and demand elasticities.

## Impacts on other Australian industries

As the skin hardening and splitting conditions are specific to the sweetpotato industry and so it is unlikely any other Australian industries may benefit from the investment in PW18001.

## Impacts overseas

This project was completed in conjunction with the LSU AgCenter and so will have also contributed to research capacity overseas and in particular in the USA.

## Results

All costs and benefits were discounted to 2020-21 using a real discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR).

## Investment criteria

As no impacts were valued, a full set of investment criteria were not able to be reported as part of this impact assessment and is limited to the Present Value of Investment Costs (PVC). The PVC was reported for the length of the project investment period plus 30 years from the last year of investment (2020-21) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

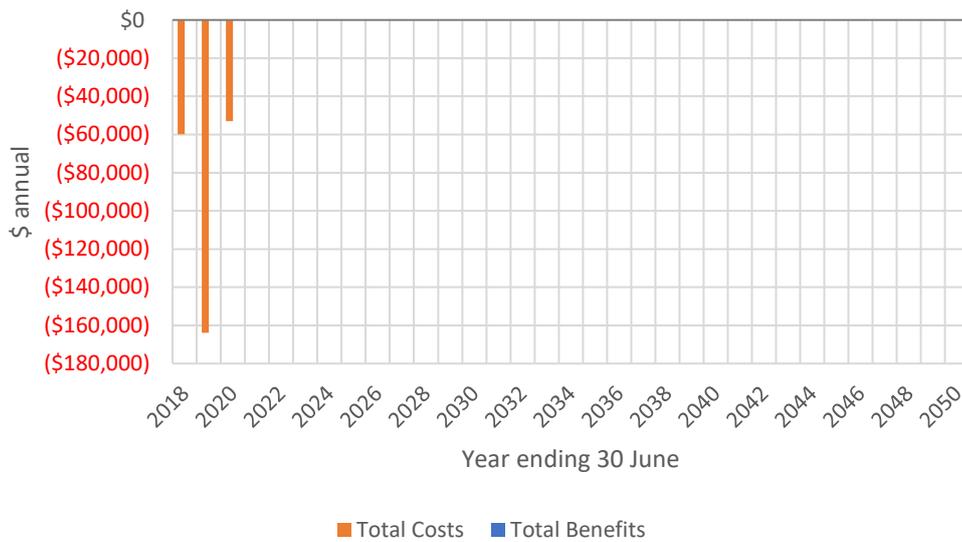
Table 5 shows the impact metrics estimated for different periods of benefit for the total investment. Hort Innovation was the only investor in PW18001.

**Table 5. Impact metrics for Total Investment in Project PW18001**

Impact metric	Years after last year of investment						
	0	5	10	15	20	25	30
PVC (\$m)	0.29	0.29	0.29	0.29	0.29	0.29	0.29

Figure 1 shows the annual undiscounted cost cash flows for the total investment of PW18001. Cash flows are shown for the duration of the investment plus 30 years from the last year of investment.

Figure 1. Annual cash flow of undiscounted total benefits and total investment costs



## Discussion and conclusions

The main impact of work under project PW18001 has been social in nature. As a pilot study the project was successful in its objectives, particularly that of building knowledge and research capability to inform future research. While benefits were unable to be quantified at this time, the information generated from PW18001 laid the foundation for a Phase 2 project (PW21002 *Causes and management strategies for skin loss in sweet potato*). This second project commenced in 2021 and demonstrates the value of research undertaken in PW18001 that will be utilised going forward with any future outcomes and impacts from the PW21002 research partially attributable to the investment in PW18001; however, given the uncertainties of the outcomes and impacts of the future research, this impact was not able to be quantified.

This investment has moved sweetpotato growers and industry both here and overseas closer to finding the causes and management options for these disorders which will likely to contribute to future reduced production losses in the industry.

The collaboration with the LSU AgCenter has strengthened relationships which has the potential to improve the working relationship, research capability and information sharing into the future. Due to the relative size of the industry in the USA, this collaborative relationship has many potential benefits for the Australian Sweet Potato industry going forward.

## Acknowledgements

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Adrian Hunt, Hort Innovation; Sarah Cumptson, Hort Innovation; Sandra Dennien, DAF

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## Glossary of economic terms

Cost-benefit analysis	A conceptual framework for the economic evaluation of projects and programs in the public sector. It differs from a financial appraisal or evaluation in that it considers all gains (benefits) and losses (costs), regardless of to whom they accrue.
Benefit-cost ratio	The ratio of the present value of investment benefits to the present value of investment costs.
Discounting	The process of relating the costs and benefits of an investment to a base year using a stated discount rate.
Internal rate of return	The discount rate at which an investment has a net present value of zero, i.e. where present value of benefits = present value of costs.
Modified internal rate of return	The internal rate of return of an investment that is modified so that the cash inflows from an investment are re-invested at the rate of the cost of capital (the re-investment rate).
Net present value	The discounted value of the benefits of an investment less the discounted value of the costs, i.e. present value of benefits - present value of costs.
Present value of benefits	The discounted value of benefits.
Present value of costs	The discounted value of investment costs.

## Abbreviations

CRRDC	Council of Rural Research and Development Corporations
DAFF	Department of Agriculture, Fisheries and Forestry (Australian Government)
GDP	Gross Domestic Product
GVP	Gross Value of Production
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
PVB	Present Value of Benefits
PVC	Present Value of Costs
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan