# Industry-specific impact assessment program: Onion

## Impact assessment report for project *Detection and management of bacterial diseases in Australian allium crops* (VN13005)

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**Project code:**

MT19012

**Date:**

December 2020

**Funding statement:**

This project has been funded by Hort Innovation, using the research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

**Publishing details:**

Published and distributed by: Hort Innovation

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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 *VN13005: Detection and management of bacterial diseases in Australian allium crops.* The project was funded by Hort Innovation over the period June 2014 to September 2017.

### 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 2019/20 dollar terms and were discounted to the year 2019/20 using a 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

The investment in VN13005 has increased onion industry capacity to manage bacterial diseases and enhanced grower preparedness for future bacterial disease incursions. This benefit has been quantified as a reduction in the cost to onion and shallot growers of future disease outbreaks.

### Investment Criteria

Total funding from all sources for the project was $0.96 million (present value terms). The investment produced estimated total benefits of $3.04 million (present value terms). This gave a net present value of $2.08 million, an estimated benefit-cost ratio of 3.18 to 1, an internal rate of return of 14.6% and a modified internal rate of return of 8.7%.

### Conclusions

A positive return has been assessed for this project. Two impacts identified were not valued, the impacts were considered uncertain and indirect compared with the impact valued. Consequently, the investment criteria provided by the valuation may be underestimates of the actual performance of the investment.



# Keywords

Impact assessment, cost-benefit analysis, onion industry, bacterial disease, *Pseudomonas syringae pv. porri, Xanthomonas axonopodis pv. allii*, bacterial blight of leek, bacterial blight of onion, coronatine toxin, copper

# Introduction

All research, development, and extension (RD&E) and marketing levy investments undertaken by Horticulture Innovation Australia Limited (Hort Innovation) are guided and aligned to specific investment outcomes, defined through a Strategic Investment Plan (SIP). The SIP guides investment of the levy to achieve each industry's vision. The current industry SIPs apply for the financial years 2016/17 – 2020/21.

In accordance with the Organisational Evaluation Framework, Hort innovation has the obligation to evaluate the performance of its investment undertaken on behalf of industry.

This impact assessment program addresses this requirement through conducting a series of industry-specific ex-post independent impact assessments of the almond (AL), banana (BA), citrus (CT) and onion (VN) RD&E investment funds.

Twenty-nine RD&E investments (projects) were selected through a stratified, random sampling process. The industry samples were as follows:

- Nine AL projects were chosen worth $5.84 million (nominal Hort Innovation investment) from an overall population of 21 projects worth an estimated $10.78 million,
- Eight BA projects worth $3.02 million (nominal Hort Innovation investment) from an overall population of 22 projects worth approximately $16.72 million,
- Eight CT projects worth $5.4 million (nominal Hort Innovation investment) from a total population of 35 projects worth $15.78 million, and
- Four VN projects worth $2.4 million (nominal Hort Innovation investment) from an overall population of 8 projects worth $3.89 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2014 to 30 June 2019.

The projects for each industry sample were chosen such that the investments represented (1) at least 10% of the total Hort Innovation RD&E investment expenditure for each industry, and (2) the SIP outcomes (proportionally) for each industry.

# General Method

The impact assessment follows 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 includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts. The principal economic, environmental, and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then 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 & Rationale

### Background

The Australian onion industry is a mature industry with stable production. It is the fourth largest vegetable crop produced in Australia and the second largest vegetable category exported. Onions are grown across most Australian states, but Tasmania and South Australia together produce 71% of the Australian crop. Queensland is the next most important state for onion production, growing 10% of the national crop. Major growing areas include the north-west region of Tasmania, Upper South Australia, the Adelaide Plains, and the Lockyer Valley of Queensland. Brown onions account for 79% of production, red onions 19%, white onions 1% and shallots/spring onions less than 1% (Hort Innovation 2020).

Other Australian allium crops include garlic, leek, chive, and a range of ornamentals. The Australian Horticulture Statistics Handbook does not provide data on the small chive or ornamental allium sectors. Onions and shallots dominate Australian allium production – Table 1.

Table 1: Australian Allium Production and Value 2015/16 to 2018/19

| Year Ended 30 June | Garlic Production (tonnes) | Garlic GVP ($m) | Leek Production (tonnes) | Leek GVP ($m) | Onion and Shallot Production (tonnes) | Onion and Shallot GVP ($m) |
|---|---|---|---|---|---|---|
| 2016 | 1,825 | 11.4 | 9,379 | 18.5 | 260,674 | 157.7 |
| 2017 | 1,786 | 13.1 | 9,051 | 20.4 | 237,635 | 174.2 |
| 2018 | 2,122 | 15.4 | 8,736 | 21.0 | 249,145 | 164.8 |
| 2019 | 2,812 | 19.2 | 10,809 | 25.7 | 258,195 | 191.2 |
| Average | 2,136 | 14.8 | 9,494 | 21.4 | 251,412 | 172.0 |

Source: Australian Horticulture Statistics Handbook 2017/18 and 2018/19

The onion industry has a statutory levy in place for RD&E, marketing, biosecurity, and residue testing programs. The RD&E levy is used for onion research, development, and extension activities across a range of disciplines targeting both on-farm and supply chain sectors in accordance with industry priorities.

Onion RD&E levy investment is guided by the Onion industry's SIP. The current SIP has been developed by levy payers and addresses the Australian onion industry's needs from 2017 to 2021. Strategies and priorities in the SIP have been driven by a set of four desired outcomes (Hort Innovation 2017):

1. Increased domestic consumption
2. Growth in export markets
3. Improved farm productivity
4. An informed and engaged industry.

### Rationale

In 2011, shallot and onion growers from the Lockyer production area of Queensland reported a new disease which was subsequently identified as bacterial blight of leek, caused by the bacterial pathogen *Pseudomonas syringae pv. Porri* (Psp). At that time the only known bacterial disease with similar symptoms affecting onion and shallot was the exotic Xanthomonas leaf blight caused by *Xanthomonas axonopodis pv.allii*.

In 2012, *Pseudomonas syringae pv. Porri* turned up on shallot and red onion plants widely distributed throughout the Lockyer Valley. Initially, growers thought the bacteria was the fungal disease downy mildew and were concerned that their chemical fungicides were no longer providing control. Laboratory tests confirmed that onion cultivars Cream Gold and Hunter River White, spring onion, and shallot were all susceptible to *Pseudomonas syringae pv. Porri*. Shallots and onions infected with *Pseudomonas syringae pv. Porri* had 'yellow leaf' syndrome which resulted in the production of a plant toxin (coronatine), spoiled the appearance of the allium, and rendered the shallot crop unmarketable. Shallot leaves are consumed as part of the crop. Onions affected by bacterial blight produced smaller bulbs.

The impact of *Pseudomonas syringae pv. Porri* on yield in Australia was unclear. However, growers in the Netherlands report the disease can cause up to 50% yield loss. The symptoms shown by *Pseudomonas syringae pv. Porri* are similar to Xanthomonas which is known to reduce yield in onions by 30% to 50%. Yield losses of up to 100% due to reduced bulb size and quality have been reported (Plant Health Australia, undated). Similar bacterium has also been shown to affect lettuce and tomato crops.

*Pseudomonas syringae pv. Porri* had previously been detected in South Australia, Victoria, and Western Australia between 2000 and 2003. There were differences in the bacterial pathogen between the Lockyer outbreak and earlier incidents suggesting that the outbreaks came from two separate incursions. It is most likely that the incursions originated in contaminated seed supplied by international seed companies.

Cool and wet weather and feeding damage caused by onion thrips were suspected of having a role in bacterial blight establishment and spread.

# Project Details

## Summary

Project Code: VN13005

Title: Detection and management of bacterial diseases in Australian allium crops

Research Organisation: Department of Agriculture and Fisheries (DAF), Queensland

Project Leader: Cherie Gambley

Period of Funding: June 2014 to September 2017

## Objectives

The objective of this project was to increase capacity in the onion industry to manage bacterial diseases such as bacterial blight of leek which affects onions and shallots. A further aim was to enhance preparedness for potential incursions of key exotic bacterial diseases such as Xanthomanas leaf blight in onion.

## Logical Framework

Table 2 provides a detailed description of the project in a logical framework.

Table 2: Logical Framework for Project VN13005

| | |
|---|---|
| Activities | Major project activities included:<br>• Review of the scientific literature on the detection, epidemiology, and management of bacterial blight on allium caused by *Pseudomonas syringae pv. Porri*.<br>• Survey of Australian onion growing districts for bacterial diseases (QLD, NSW, VIC, SA, TAS), collection and analysis of disease and weather data. Surveys included red, brown, white onion, and shallot crops. Surveys revealed that the disease was confined to QLD.<br>• Pathogenicity and laboratory studies to compare QLD isolates with earlier leek samples.<br>• Completion of experiments to study the influence of temperature on bacterial disease in order to deliver improved early season forecasts of disease related crop loss.<br>• Testing that determined that *Pseudomonas syringae pv. Porri* has a negative impact on onion seed germination and seedling establishment.<br>• Research potential seed transmission of the exotic bacterium using samples obtained from seed linked to the 2011 and 2012 Queensland outbreaks.<br>• Documentation of knowledge on the survival of *Pseudomonas syringae pv. Porri* within and between crop cycles.<br>• Research potential disease control methods i.e. different formulations of copper, clove oil, chemicals, cultural practices (e.g. planting times, irrigation regimes, movement of people/equipment through the crop), biological control agents, and tolerant plant lines.<br>• Preparation and delivery of relevant extension/training materials that address disease identification and management options including factsheets, articles in Onions Australia, industry web pages and industry workshop/conference presentations.<br>• Extension materials delivered via growing district workshops, distribution of factsheets, and placement of factsheets on Onions Australia and Plant Health Australia websites.<br>• Preparation of project related scientific papers, and a final project report. |
| Outputs | The important outputs of the project were:<br>• An improved understanding of the: introduction, spread and survival of bacterial pathogens in allium crops. Multiple strains are apparent and given potential transmission via imported seeds, it is possible that future incursions will occur and may be more lethal.<br>• Protocols for *Pseudomonas syringae pv. Porri* detection.<br>• Identification of control methods to manage bacterial diseases of the Australian onion industry. There is a lack of suitable bactericides. Commercial onion and shallot varieties do not express bacterial blight resistance. Measures are required to control thrips, |

| | |
|---|---|
| | minimise mechanical wounding and leaf wetness. Copper is likely to be effective against the bacteria. However, further research is required to determine appropriate spray regimes and formulations.<br>• The project has delivered enhanced industry preparedness when faced with incursions of economically important exotic bacteria. The project has delivered data on current infection levels, raised industry awareness, and provided industry with tools to identify and minimise the impact of the bacteria.<br>• The factsheet for Xanthomonas blight of onion, caused by *Xanthomonas axonopodis* pv. *allii* was developed, endorsed, and hosted by Plant Health Australia. |
| Outcomes | • Reduction in the future impact of exotic bacterial diseases to the Australian onion and shallot industry. |
| Impacts | • Economic – reduction in the cost to onion and shallot growers of future outbreaks of exotic bacterial disease (i.e. avoided loss of yield and quality).<br>• Capacity – researchers and growers with an additional understanding and awareness of bacterial diseases in onion and shallot crops and how to manage them.<br>• Social – future contribution to improved regional community wellbeing with more profitable and sustainable onion and shallot growers. |

# Project Investment

### Nominal Investment

Table 3 shows the annual investment made in Project VN13005. The project included contributions from both Hort Innovation and DAF.

Table 3: Annual Investment in Project VN13005 (nominal $)

| Year ended 30 June | HORT INNOVATION ($) | DAF ($) | TOTAL ($) |
|---|---|---|---|
| 2014 | 67,809 | 89,374 | 157,183 |
| 2015 | 82,037 | 108,126 | 190,163 |
| 2016 | 74,470 | 98,153 | 172,623 |
| 2017 | 56,079 | 73,913 | 129,992 |
| **Total** | **280,395** | **369,566** | **649,961** |

Source: VN13005 Variation Agreement, May 2017

### Program Management Costs

For the Hort Innovation investment the cost of managing the Hort Innovation funding was added to the Hort Innovation contribution for the project via a management cost multiplier (1.162). This multiplier was estimated based on the share of 'payments to suppliers and employees' in total Hort Innovation expenditure (3-year average) reported in the Hort Innovation's Statement of Cash Flows (Hort Innovation Annual Report, various years). This multiplier was then applied to the nominal investment by Hort Innovation shown in Table 3.

### Real Investment and Extension Costs

For the purposes of the investment analysis, the investment costs of all parties were expressed in 2019/20 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2020). No additional costs of extension were included; the project was strongly focused on the production and dissemination of extension materials for onion and shallot growers.

# Impacts

Table 4 provides a summary of the principal types of impacts delivered by the project, based on the logical framework. Impacts have been categorised into economic, environmental, and social impacts.

Table 4: Triple Bottom Line Categories of Principal Impacts from Project VN13005

| | |
|---|---|
| Economic | • Reduction in the cost to onion and shallot growers of future outbreaks of exotic bacterial disease (i.e. avoided loss of yield and quality). |
| Environmental | • Nil. |
| Social | • Researchers and growers with additional capacity including understanding and awareness of bacterial diseases in onion and shallot crops and how to manage them.<br>• Future contribution to improved regional community wellbeing with more profitable and sustainable onion and shallot growers. |

### Public versus Private Impacts

Impacts from investment in VN13005 will be mainly private and realised by onion and shallot growers through avoided yield loss caused by exotic bacterial disease outbreaks.

### Distribution of Private Impacts

Economic benefits from avoided loss of yield will be shared along the supply chain with input suppliers (e.g. seed, chemical, fertiliser), transporters, wholesalers, exporters, retailers, and consumers all benefiting. The share of benefit realised by each link in the supply chain will depend on both short- and long-term supply and demand elasticities in domestic and export onion markets.

### Impacts on Other Australian Industries

Capacity developed through this project and directly benefiting onion and shallot growers will also be relevant to growers of other allium species (i.e. garlic, leek, chive, and ornamental allium) and may also have relevance to growers of other vegetable crops, (e.g. lettuce and tomato) which are known to be susceptible to similar types of exotic bacteria.

### Impacts Overseas

The research indicates that Australian onion and shallot crop infection with exotic bacteria was most likely caused by contaminated seed supplied by international seed companies. Onion and shallot industries in other countries will also be susceptible to this infection pathway. Additional knowledge on the bacteria and treatment options will also be valuable to these overseas industries.

### Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project outcomes and related impacts will contribute to Rural RD&E Priorities 2 and 4 as well as Science and Research Priority 1.

Table 5: Australian Government Research Priorities

| **Australian Government** | |
|---|---|
| **Rural RD&E Priorities (est. 2015)** | **Science and Research Priorities (est. 2015)** |
| 1. Advanced technology<br>2. Biosecurity<br>3. Soil, water and managing natural resources<br>4. Adoption of R&D | 1. Food<br>2. Soil and Water<br>3. Transport<br>4. Cybersecurity<br>5. Energy and Resources<br>6. Manufacturing<br>7. Environmental Change<br>8. Health |

Sources: (DAWR, 2015) and (OCS, 2015)

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

The strategic outcomes and strategies of the onion industry are outlined in the Onion Industry's Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project VN13005 commenced prior to the industry's current SIP. Nevertheless, the project aligns with Outcome 3 'reduced costs and improved returns to growers through improvements in business and production skills', strategies 2 and 6. Strategy 2 is 'continue with a prioritised R&D program to manage pest and disease challenges and threats with a focus on soil health and IPM'. Strategy 6 is 'investigate issues around seed quality, availability and variety selection appropriate to regional conditions'.

## Valuation of Impacts

### Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

A single key impact was valued – reduction in the cost to onion and shallot growers of future outbreaks of exotic bacterial disease.

### Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. The two social impacts identified but not valued were:

- Researchers and growers with additional capacity including understanding and awareness of bacterial diseases in onion and shallot crops and how to manage them.
- Future contribution to improved regional community wellbeing with more profitable and sustainable onion and shallot growers.

These potential social impacts were not valued due to an absence of data that would allow the development of credible assumptions.

### Valuation of Impact: reduction in the cost to onion and shallot growers of future outbreaks of exotic bacterial disease.

The VN13005 investment has generated and communicated additional knowledge to support early detection and control of exotic bacterial diseases in onions and shallots. This additional knowledge will reduce future economic losses associated with these diseases. Overseas, *Pseudomonas syringae pv. porri* has been associated with onion yield losses of between 30% and 50%. The project developed fact sheet notes that yield loss may be 100%.

**Attribution**

The project built on preliminary work completed following the incursion of *Pseudomonas syringae pv. porri* in South Australia, Victoria, and Western Australia between 2000 and 2003. Consequently a 75% attribution factor has been used for the VN13005 impact assessment, 25% of project benefit is attributed to the previous research work.

**Counterfactual**

The scenario assumed if the investment had not been made is that it is 25% likely that some other project would have addressed detection and management of bacterial diseases in onions and shallots.

### Summary of Assumptions

A summary of the key assumptions made for valuation of the impacts is shown in Table 6.

[1] For further information, see: https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/

Table 6: Summary of Assumptions

| Variable | Assumption | Source/Comment |
|---|---|---|
| **Impact 1: reduction in the cost to onion and shallot growers of future outbreaks of exotic bacterial disease** | | |
| Australian onion and shallot production. | 247,423 tonnes. | 5 year average 2015 to 2019, Horticulture Statistics Handbook 2017/18 and 2018/19. |
| Share of total onion and shallot crop impacted by bacterial diseases in the absence of VN13005 project outputs. | 1% in 2018/19<br>3% from 2023/24. | Consultant estimate and tested using sensitivity analysis. |
| Loss in onion and shallot yield in bacterial disease impacted crops. | 40%. | Yield losses recorded between 30% and 50% and sometimes up to 100% due to reduced bulb size and quality https://www.planthealthaustralia.com.au/wp-content/uploads/2016/07/Bacterial-onion-blight-FS.pdf |
| Farmgate profit on avoided yield loss. | $155/tonne. | Onion and shallot price of $459/tonne and costs of production of $304/tonne (ABARES data on AUSVEG website,https://ausveg.com.au/resources/economics-statistics/australian-vegetable-production-statistics/#pricecost |
| Probability of VN13005 generating valuable outputs. | 90% | Project has built capacity and identified onion blight control measures. Some further work required determining appropriate spray regimes and formulations for copper based controls. |
| Probability of VN13005 outcome adoption. | 90% | Project has been extended to growers through factsheets, articles, and workshops. Nevertheless, there remains some possibility that growers will choose not to adopt. |

# Results

All costs and benefits were discounted to 2019/20 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the project investment period plus 30 years from the last year of investment (2016/17) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

## Investment Criteria

Tables 7 and 8 show the investment criteria estimated for different periods of benefit for the total investment and Hort Innovation investment, respectively. The present value of benefits (PVB) attributable to Hort Innovation investment only, shown in Table 8, has been estimated by multiplying the total PVB by the Hort Innovation proportion of real investment (46.9%).

Table 7: Investment Criteria for Total Investment in Project VN13005

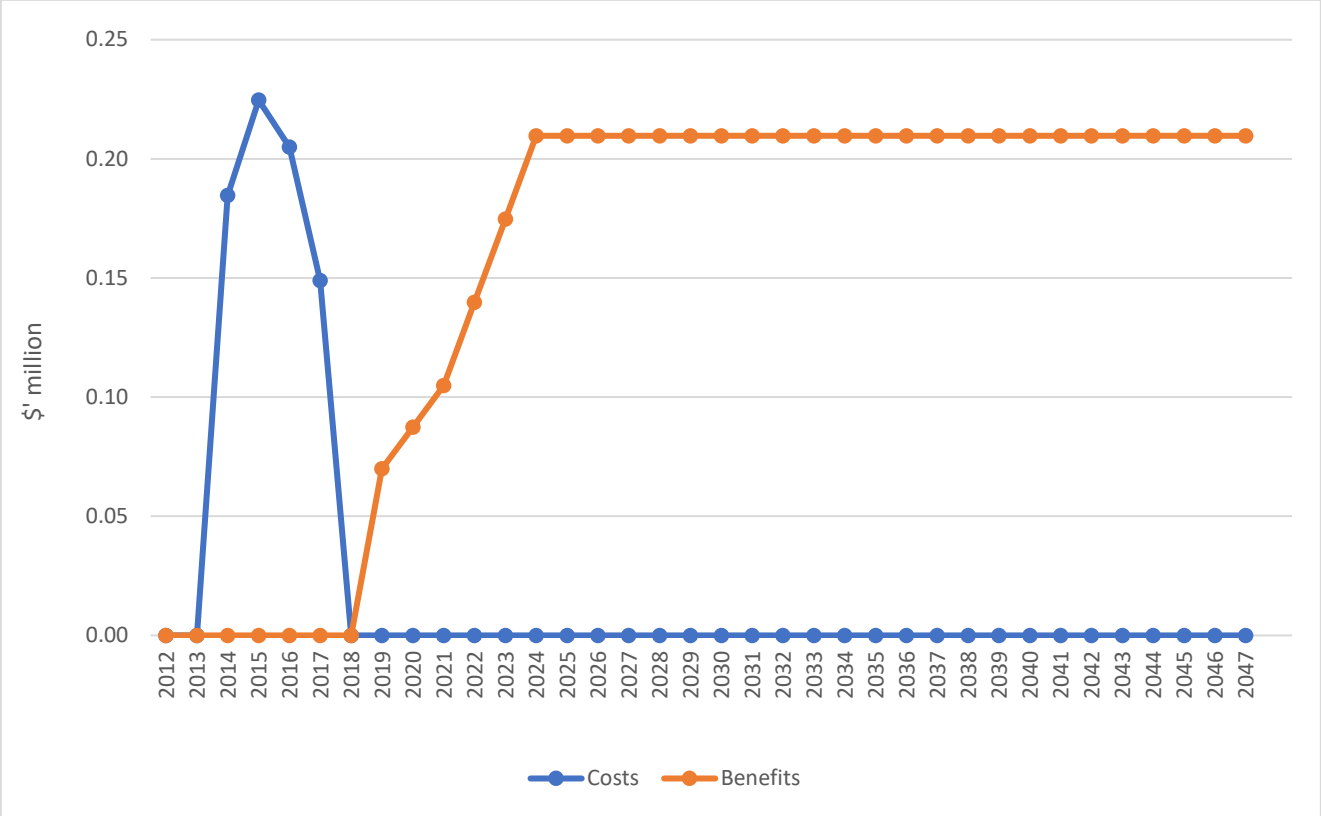
| Investment Criteria | Years after Last Year of Investment | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| Present Value of Benefits ($m) | 0.00 | 0.39 | 1.18 | 1.83 | 2.33 | 2.73 | 3.04 |
| Present Value of Costs ($m) | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 |
| Net Present Value ($m) | -0.96 | -0.57 | 0.22 | 0.87 | 1.38 | 1.77 | 2.08 |
| Benefit-Cost Ratio | 0.00 | 0.41 | 1.24 | 1.91 | 2.44 | 2.85 | 3.18 |
| Internal Rate of Return (%) | negative | negative | 6.5 | 11.8 | 13.6 | 14.3 | 14.6 |
| MIRR (%) | negative | negative | 5.9 | 8.7 | 9.1 | 9.0 | 8.7 |

Table 8: Investment Criteria for Hort Innovation Investment in Project VN13005

| Investment Criteria | Years after Last Year of Investment | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| Present Value of Benefits ($m) | 0.00 | 0.18 | 0.55 | 0.86 | 1.09 | 1.28 | 1.42 |
| Present Value of Costs ($m) | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| Net Present Value ($m) | -0.45 | -0.27 | 0.11 | 0.41 | 0.64 | 0.83 | 0.98 |
| Benefit-Cost Ratio | 0.00 | 0.41 | 1.24 | 1.91 | 2.44 | 2.85 | 3.18 |
| Internal Rate of Return (%) | negative | negative | 6.5 | 11.8 | 13.6 | 14.3 | 14.6 |
| MIRR (%) | negative | negative | 5.9 | 8.7 | 9.1 | 9.0 | 8.7 |

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the VN13005 investment plus 30 years from the last year of investment are shown in Figure 2.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs




## Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 9 presents the results. The results show some sensitivity to the discount rate.

Table 9: Sensitivity to Discount Rate
(Total investment, 30 years)

| Investment Criteria | Discount rate | | |
|---|---|---|---|
| | 0% | 5% (base) | 10% |
| Present Value of Benefits ($m) | 5.61 | 3.04 | 1.92 |
| Present Value of Costs ($m) | 0.76 | 0.96 | 1.19 |
| Net Present Value ($m) | 4.85 | 2.08 | 0.73 |
| Benefit-cost ratio | 7.35 | 3.18 | 1.62 |

A sensitivity analysis was then undertaken for the share of onion and shallot crop impacted by bacterial blight. Results are provided in Table 10. The project 'breaks even' when share of crop impacted is 0.2% in 2019/20 and 1.0% in 2023/24.

Table 10: Sensitivity to Share of Onion and Shallot Crop Impacted by Bacterial Blight
(Total investment, 30 years)

| **Investment Criteria** | **Share of Crop Impacted** | | |
|---|---|---|---|
| | **0.2% in 2019/20 1.0% from 2023/24** | **1% in 2019/20 3% from 2023/24** | **2% in 2019/20 6% from 2023/24** |
| Present Value of Benefits ($m) | 0.99 | 3.04 | 6.01 |
| Present Value of Costs ($m) | 0.96 | 0.96 | 0.96 |
| Net Present Value ($m) | 0.04 | 2.08 | 5.06 |
| Benefit-cost ratio | 1.04 | 3.18 | 6.29 |

A final sensitivity analysis tested the sensitivity of the investment criteria to the loss of onion and shallot yield in bacterial disease impacted crops. The results (Table 11) show that the investment criteria remain positive with a halving of the assumed yield loss.

Table 11: Sensitivity to Assumed Yield Loss
(Total investment, 30 years)

| **Investment Criteria** | **Yield Loss Caused by Bacterial Blight** | | |
|---|---|---|---|
| | **20%** | **40% (base)** | **80%** |
| Present Value of Benefits ($m) | 1.52 | 3.04 | 6.08 |
| Present Value of Costs ($m) | 0.96 | 0.96 | 0.96 |
| Net Present Value ($m) | 0.56 | 2.08 | 5.12 |
| Benefit-cost ratio | 1.59 | 3.18 | 6.36 |

### Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 12). The rating categories used are High, Medium, and Low, where:

High: denotes a good coverage of benefits or reasonable confidence in the assumptions made

Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made

Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 12: Confidence in Analysis of Project

| **Coverage of Benefits** | **Confidence in Assumptions** |
|---|---|
| Medium-High | Medium |

Coverage of benefits valued was assessed as Medium-High. While the key impact – reduction in the cost to onion and shallot growers of future outbreaks of exotic bacterial disease – was valued, two other impacts were not quantified. Confidence in assumptions was rated as Medium, most of the data used came from credible sources, some key assumptions were made by the analyst.

# Conclusion

The investment in VN13005 has increased onion industry capacity to manage bacterial diseases and enhanced grower preparedness for future bacterial disease incursions. This benefit has been quantified as a reduction in the cost to onion and shallot growers of future disease outbreaks.

Total funding from all sources for the project was $0.96 million (present value terms). The investment produced estimated total expected benefits of $3.04 million (present value terms). This gave a net present value of $2.08 million, an estimated benefit-cost ratio of 3.18 to 1, an internal rate of return of 14.6% and a modified internal rate of return of 8.7%.

As two impacts identified were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

# 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. |
| Investment criteria: | Measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return. |
| 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. |

# Reference List

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# Acknowledgements

AgEconPlus and Agtrans Research would like to thank all the project and program personnel associated with Horticulture Innovation Australia Limited that were involved in the evaluation process. Their cooperation and feedback throughout the evaluation process contributed significantly to this report.

Specific acknowledgements:
Lechelle Earl, Onions Australia
Cherie Gambley, Pathologist, DAF
Brenda Kranz, R&D Manager, Hort Innovation
Brendan O'Keeffe, Analyst, Hort Innovation
Mark Spees, Industry Strategic Partner, Hort Innovation

# Abbreviations

| | |
|---|---|
| AL | Almond |
| BA | Banana |
| CRRDC | Council of Research and Development Corporations |
| CT | Citrus |
| DAF | (Queensland) Department of Agriculture and Fisheries |
| DAWR | Department of Agriculture and Water Resources (Australian Government) |
| GDP | Gross Domestic Product |
| GVP | Gross Value of Production |
| IRR | Internal Rate of Return |
| MIRR | Modified Internal Rate of Return |
| OCS | Office of Chief Scientist Queensland |
| PVB | Present Value of Benefits |
| RD&E | Research, Development and Extension |
| VN | Onion |