# Adding value on the farm for Queensland broccoli growers: broccoli seed production

## Agri-Science Queensland Innovation Opportunity

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This publication has been compiled by Clinton McGrath of Agriscience Queensland, Department of Agriculture and Fisheries.

# Summary

*Fresh broccoli is a popular and important crop to the Queensland vegetable industry. This project investigated the concept of producing broccoli seed from the crop residue after harvest of broccoli heads, which has the potential to add a new revenue stream for broccoli growers.*

*Broccoli seed has many uses including broccoli sprouts, broccoli sprout extract, broccoli seed oil and vitamins. These products are gaining interest in the cosmetic and health care industry.*

*Broccoli seed yield equivalent of 108kg/ha was produced after a normal harvest of broccoli equivalent to 8.8 tonnes/ha in a field trial in 2017/18 at Stanthorpe. With key assumptions of seed price of $24/kg and harvesting and grading costs similar to canola, this could potentially add $2,358/ha to the bottom line of a commercial broccoli producer.*

*Broccoli seed from the trial was germination tested and had a germination of 99% at 10 days after sowing (DAS) indicating potential for the broccoli seed sprout market.*

*A strong interest exists amongst Australian broccoli seed users for an Australian product and further research and development seems warranted to pursue the concept with broccoli growers.*

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# Background

Broccoli (*Brassica oleraceae* cv. Italica) is a vegetable grown for its immature flower head and is very popular in Australia with 69% of households purchasing in 2016/17 (Horticulture.com.au, 2018).

Queensland produced 22,573 tonnes of fresh broccoli worth $68.58 million dollars at the wholesale level in 2016/17, this represents 30% of national production (Figure 1) (Horticulture.com.au, 2018). It is grown all year round in southern Queensland with majority produced throughout winter in the Lockyer Valley. In 2016/17, broccoli was Queensland's largest exported vegetable crop with 3,199 tonnes exported (Horticulture.com.au, 2018).

In the production of broccoli, after harvesting the immature flower head, significant amounts of plant material is left behind in the field (Figure 2). The plant appears to have potential to continue growing and produce secondary flowers and ultimately broccoli seed. This project aimed to determine if Queensland broccoli crops can be harvested for fresh immature flower heads as per normal production process and then further develop seed to be harvested for broccoli seed markets. As a lot of production costs, such as planting and establishment have already occurred, seed production could potentially add value and improve revenue to Queensland broccoli producers.

Broccoli seed has a variety of uses such as broccoli sprouts, broccoli seed oil for cosmetic use, broccoli seed extract and extraction of chemical compounds, in particular glucosinolates. Some of these products have high value (see Figures 4, 5 & 6). Surveys conducted in 2017/18 by the researcher indicate sprouting broccoli seed sells between a range of $24- $300/kg, broccoli seed oil approximately $200/L, broccoli sprouts $25 – $40/kg and broccoli seed extract and sprout powder between $300 - $400/kg (Figures 2, 3, 4)

Of recent interest is the glucosinolate present in brassica vegetables, glucoraphanin. Glucoraphanin is present in relatively high quantities in broccoli seed and resulting sprouts (Farnham et al., 2005, Fahey et al., 2002, YouTube, 2018). Glucoraphanin can be converted to sulforaphane (SFN), a compound with various cancer protective, cancer fighting, antioxidant and gene expression modulator properties,

Sulforaphane has been suggested as a new potential anti-diabetic compound, with its effectiveness on Type 2 diabetes offering potential in recent human clinical trials similar to levels of a common medication metformin (Tubbs et al., 2018). Diabetes is a chronic disease characterised by high levels of glucose in the blood, with the Australian Department of Health reports that in 2014 – 15 an estimated 1,200,000 people, or 5.1% of the population in Australia had diabetes which was an increase up from 4.4% of the population in 2011/12 (Health.gov.au, 2018). Type 2 diabetes represented 85% of all diabetes (Health.gov.au, 2018).

The potential uses and demand of broccoli seed and products thus indicates a prospective opportunity for production for Queensland broccoli farmers if suitable seed (quality and quantity) could be produced.

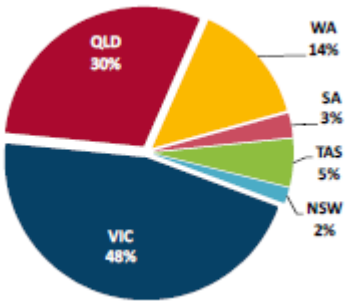


*Figure 1 Australian broccoli production by state 2016/17 (ABS Data)*

*Figure 2 Broccoli field crop remains after harvesting immature flower heads*


*Figure 3 Queensland broccoli in retail supermarket*


*Figure 4 Australian grown broccoli sprouts retail package*


*Figure 5 cosmetic product containing broccoli seed oil, Product of USA*


*Figure 6 Australian produced broccoli sprout powder*

# Project Objectives

This project aimed to:

- Establish a field trial to determine if broccoli seed could be produced from broccoli fields after fresh broccoli was harvested. Trial findings could be used to determine seed suitability and determine agronomic and other requirements.
- Deliver findings from the trial to Queensland broccoli growers and discuss findings and potential with other prospective supply chain partners
- Determine some seed quality and chemical comparisons with existing imported broccoli seeds
- Develop a supply chain map of a potential broccoli seed industry

# Methodology

## Field Trial

Broccoli seedlings were planted on a commercial vegetable farm in Stanthorpe on October 16, 2017. This is a normal planting window for the region. A hybrid variety commercially grown was used at normal plant spacing with intention to be grown as a commercial (fresh market) crop. Plant population was 44,000 per ha. At the same time, seeds of sprouting broccoli sourced from a commercial broccoli sprout producer were also planted for observation and seed production for further testing.

The crop was fertilised and crop protection products applied as per a normal crop. Broccoli heads were harvested over a 10 day period commencing December 17, 2017. Estimated yields were equivalent to 1,100 x 8Kg cartons/ ha.

After harvest, instead of destroying the crop residue, the crop was allowed to produce secondary flowers and subsequently develop seed. Time of flowering and harvest of seed was determined, with flowering commencing on January 16, 2018 and seed harvested March, 18, 2018.

The broccoli sprouting variety was grown out and seed recovered for comparison testing of seed grown from the commercial variety.

Seed collected was then stored in cool dry conditions for further testing

## Communication and industry engagement activities

Interested broccoli growers and other vegetable growers were invited to inspect the crop at flowering with the project and background objectives outlined.

Industry was scanned to identify potential broccoli seed customers and service providers capable of harvesting, grading and storing the seed. Discussions were intended to determine interest in Australian broccoli seed production.

## Seed testing and chemical composition

Once harvested, broccoli seed sourced from the hybrid commercial variety, seed sourced from the sprout seed plants and the original seed lines were sent to Queensland Seed Testing Laboratory for germination and seed measurements, in particular the seed weight.

## Development of broccoli seed gross margin

Data collected from commercial growers in the Stanthorpe region, data from the field trial and surveys of seed service providers (harvesters and processors) were collected and a gross margin developed for broccoli fresh production plus the seed production option.

# Results

## Field Trial

Hybrid broccoli successfully grew to head harvest at 62 days (October 16 to December 17). Estimated yields of market quality broccoli was 8.8 t/Ha or 1100 x 8kg cartons. This is considered an average or normal yield for commercial fresh market broccoli in the region.

Hybrid broccoli flowered approximately 4 weeks after harvest from auxiliary shoots on the plants (Figure 7). Abundant amounts of flowering appeared to occur.

Seed was harvested from the hybrid plants on March 16, 2018 or 153 days after planting. Seed was harvested by manually collecting seed stalks and thrashing the siliques (seed capsules) by hand.

Seed yield was equivalent to 108.65 kg/ha. Observations included very low seed set in the crop. There were many unfertilised or aborted siliquas on the plants (Figure 8). Less than 10 percent of potential seed capsules were set. Determination was sort by discussions with broccoli plant breeders and it is suggested that modern day hybrids are not self-fertile and insect pollinators are required for best results. Bees were observed during the flowering period on the field trial (Figure 9) suggesting subsequent seed production would require a polliniser variety to be planted synchronously with the crop to increase yields. This suggestion is supported by an article produced by the Arizona University suggesting cross pollination between varieties with fertile male and female flowers and use of insect pollinators can result in higher average seed weight (Cals.arizona.edu, 2018)

*Figure 7 Hybrid broccoli flowering, January 2018*

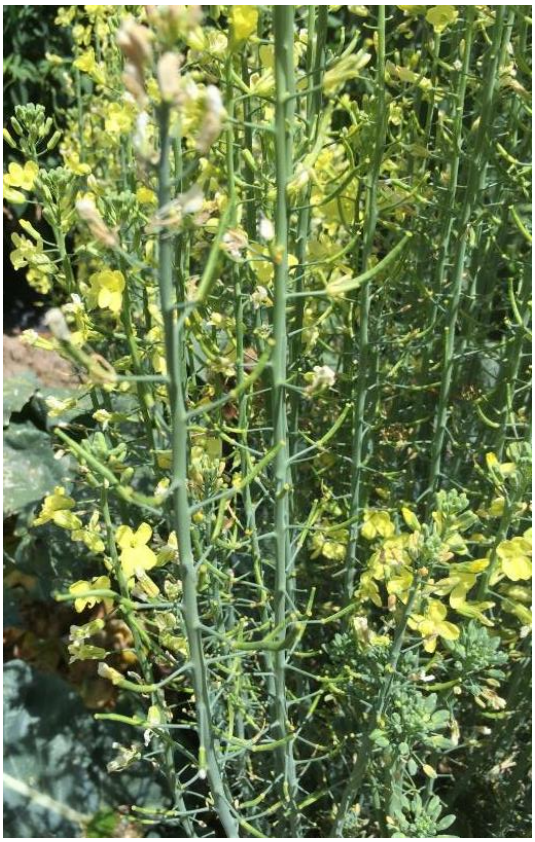

*Figure 8 Hybrid broccoli flower stalk showing aborted and unfilled siliqua, February, 2018*

*Figure 9 Bees foraging in broccoli flowers, February 2018*

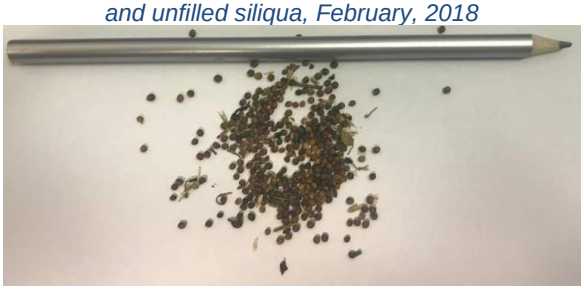

*Figure 10 Broccoli seed produced from hybrid broccoli plants, 2018.*

## Seed Quality Testing

Seed collected from the field trial, along with original sprouting broccoli seed and hybrid variety were sent to Queensland Seed Testing Laboratories for germination and seed weight analysis. Results are shown in Table 1.

Germination for the hybrid offspring was the best for all samples (99% at 10 days); this indicates it has potential for the broccoli seed sprouting market.

Seed collected and sprouted, or germinated, for further observation indicated good field germination and obvious genetic vigour differences (Figure 11).

***Table 1 – Comparison of some seed quality traits between imported sprouting broccoli seeds, standard industry hybrid broccoli variety and seed produced from field plantings of each type***

| Seed type | Germination (10 days) % | 1000seed weight (g) |
|---|---|---|
| **Original hybrid** | **85** | **5.855** |
| **Original sprouting** | **98** | **3.163** |
| **Hybrid offspring** | **99** | **4.878** |
| **Sprouting offspring** | **90** | **4.383** |

*Figure 11 Germinated broccoli seed from the field trial prior to glucosinolate testing, showing obvious vigour differences.*

## Communication and industry engagement activities

Local vegetable farmers were engaged to view the field trial (Figure 12) and presented with the project key objectives. This was used as a two-way information flow between the researcher and farmers to gauge interest in the concept of broccoli seed production and also any potential issues. Generally, the farmers were supportive of the concept of seed production. Some observations included lack of understanding of the seed harvest systems and processes for a vegetable farmer, tying up of limited resources (primarily land and water) and potential for other products derived from broccoli plants, including as a stock feed.

Presentation of the project concept and preliminary findings were presented at vegetable grower seminars in Stanthorpe and Gatton in 2018.

Potential service providers of seed harvesting and grading were also contacted to discuss the concept. It was generally agreed that the crop might behave similarly to canola and thus similar harvesting and grading techniques could be used in future trials. Estimated commercial rates were obtained for the gross margin analysis.

Engagement of identified broccoli seed users in Australia indicated some exciting potential. Sprout producers, sprout powder manufacturers and vitamin companies were contacted and were provided with an overview of the concept. All processers expressed a willingness to be involved in further

activities. All broccoli seed currently used in production is imported. A key observation was the connection between health conscious consumers and broccoli seed products suggesting potential health benefits of these products are well known by some groups of consumers. Of interest was that all these companies were exporting products from Australia indicating potential export demand.

*Figure 12 Southern Queensland vegetable growers inspect field trial and discuss opportunities and challenges of the concept*

## Gross margin analysis

Using the DAF Agmargins tool (agmargins.net.au) and data collected from commercial farmers and service providers, gross margins were simulated for broccoli and broccoli plus seed production options (Appendix 1).

Key assumptions were:

- Yield of fresh broccoli 1100 8kg boxes/ha Average price $16
- Actual trial yield of 108kg of broccoli seed/ha Average price $24/kg
- Broccoli seed harvest costs of $200/ha (industry estimate)
- Broccoli seed cleaning and grading costs $300/tonne (industry estimate)

Based on the above assumptions, the findings indicated that broccoli production as a stand-alone operation could produce a gross margin of $2,622/ha. The gross margin with a simulated broccoli seed crop and yield would be $264/ha.

This indicates that broccoli seed does have the potential to increase revenue for broccoli growers. If yields were to increase, the revenue increase could be quite lucrative for the grower. Further investigation is warranted.

## Supply chain mapping

A potential supply chain map has been developed (see Appendix 2). The supply chain map includes seed production after harvest of broccoli for fresh market and includes seed production, harvesting and grading and broccoli seed markets.

# Conclusions/Significance/Recommendations

From this pilot level project, broccoli seed production following the production of a commercial fresh market crop has potential. Broccoli seed was able to be produced and collected from plants following the harvest of broccoli heads for the fresh market. This trial harvested the equivalent of 108 kg/ha of seed, which was considered low, compared to the potential amount of flowering of the crop. The use of pollinisers and insect pollinators may assist increase yield. Further research is warranted to explore the value of incorporating pollinisers within a commercial production setting.

Even at a low yield of 108kg/ha of broccoli seed, this has potential to add value for broccoli growers by increasing revenue from the crop. If yields of seed can be increased, the crop could be potentially very lucrative for growers.

Broccoli seed has a variety of uses including broccoli sprouts, broccoli sprout extract, broccoli seed extract and broccoli seed oil. The potential use of these products as a health care product is very exciting.

Strong interest exists amongst Australian broccoli seed users for Australian grown broccoli seed however further engagement and trials with broccoli growers to further advance the concept are required.

Summary of key R&D needs

- Trial broccoli seed production with the inclusion of a polliniser variety and/or insect pollinators.
- Increase the robustness of the gross margins produced in this pilot with a more concerted evaluation this production system
- Test seed for glucosinolate profile with comparison of existing broccoli seed varieties
- Test seed through existing broccoli seed users supply chains.

# Key Messages

- Producing broccoli seed following commercial fresh market broccoli cropping is possible and this has potential to add additional value for broccoli growers.
- Broccoli seed has many uses and strong potential in health care uses.
- Further research is required to advance the broccoli seed concept.

# Where to next

Discussions are currently occurring with the University of Southern Queensland around testing some of the health benefits from seed. Potential exists for a collaborative project.

A concept note will be developed for Horticulture Innovation Limited around investigating other value adding opportunities for vegetable crops, crop residue and crop products. For example broccoli and other crop waste and residue could have potential as a stockfeed, especially in drought situations.

## Budget Summary

| | |
|---|---|
| Employee related expenses | $9,837.35 |
| Supplies and services | $3340.98 |
| **Total** | **$13,178.33** |

## References


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Tubbs E, Annika S. Axelsson, Guillaume Vial, Claes B. Wollheim, Jennifer Rieusset, Anders H. Rosengren, Sulforaphane improves disrupted ER-mitochondria interactions and suppresses exaggerated hepatic glucose production,Molecular and Cellular Endocrinology,Volume 461,

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# Appendix 1 Gross margins Broccoli and Broccoli plus seed option

## Broccoli (Irrigated) Southern Downs 2018

**Gross Margin: -$2,622 /ha**

QUEENSLAND GOVERNMENT

### Income

| | QTY | YIELD | PRICE | TOTAL |
|---|---|---|---|---|
| Broccoli | | 1100 (8kg) styros/ha | 16 $/styro | $17600 /ha |

**Total Income: $17600 /ha**

### Variable Costs

| | QTY | RATE | COST | TOTAL |
|---|---|---|---|---|
| **Preparation** | | | | |
| Operation: Ripper + FWA Light FORM | 1 operation | 1 ha/hr | 33.93 $/hr | $34 /ha |
| Contract: Labour (hours) | | 4 hr/ha | 27 $/hr | $108 /ha |
| Operation: Spreader + FWA Light FORM | 1 operation | 1 ha/hr | 31.66 $/hr | $32 /ha |
| | | | | **Total Costs: $174 /ha** |
| **Planting** | | | | |
| Seedlings: Broccoli | 1 application | 44000 plants/ha | 0.08 $/seedling | $3520 /ha |
| Operation: Planting + FWA Light FORM | 1 operation | 3.75 hr/ha | 127.04 $/hr | $476 /ha |
| Contract: Labour (hours) | | 60 hr/ha | 27 $/hr | $1620 /ha |
| | | | | **Total Costs: $5616 /ha** |
| **Nutrition** | | | | |
| Nutrient: Calcium Nitrate - Farm Gate | 4 application | 100 kg/ha | 0.56 $/kg | $223 /ha |
| Nutrient: Potassium Nitrate - Farm Gate | 4 application | 100 kg/ha | 1.36 $/kg | $543 /ha |
| Nutrient: CK55 - Farm Gate | 1 application | 400 kg/ha | 0.81 $/kg | $323 /ha |
| | | | | **Total Costs: $1090 /ha** |
| **Irrigation** | | | | |
| Irrigation: Hand Shift (FORM) | | 2 ML/ha | 70 $/ML | $140 /ha |
| Consumable: Water | | 2 ML/ha | 20 $/ML | $40 /ha |
| Irrigation: Water License | | 0 ML/ha | 100 $/ML | $0 /ha |
| Contract: Labour (hours) | | 2 hr/ha | 27 $/hr | $54 /ha |
| | | | | **Total Costs: $234 /ha** |

| Crop Protection | | | | |
|---|---|---|---|---|
| Operation: Self-propelled sprayer FORM | 6 operation | 6 ha/hr | 60.7 $/hr | $61 /ha |
| Fungicide: Azoxystrobin (e.g. Amistar 250 SC) | 2 application | 0.5 L/ha | 47 $/L | $47 /ha |
| Fungicide: Copper Oxychloride (e.g. Coppox WG) | 2 application | 0.2 kg/ha | 13.53 $/kg | $5 /ha |
| Insecticide: Flubendiamide (e.g. Belt 480 SC) | 3 application | 0.1 L/ha | 810.04 $/L | $243 /ha |
| Insecticide: Imidacloprid (e.g. Confidor 200 SC) | 1 application | 1.8 L/ha | 66.5 $/L | $120 /ha |
| Herbicide: Trifluralin + Hydrocarbon (e.g. Trifluralin 480 EC) | 1 application | 2 L/ha | 8.75 $/L | $18 /ha |
| Insecticide: Emamectin Benzoate (e.g. Proclaim) | 2 application | 0.3 kg/ha | 360 $/kg | $216 /ha |
| Contract: Crop agronomy/protection | | 4 ha/hr | 102.6 $/hr | $26 /ha |
| Contract: Labour (hours) | | 3 hr/ha | 27 $/hr | $81 /ha |
| | | | | **Total Costs: $816 /ha** |
| **Harvesting** | | | | |
| Contract: Labour picking | 1100 (8kg) styros/ha | 15 styro/hr | 27 $/hr | $1980 /ha |
| Contract: Labour packing machine labour | 1100 (8kg) styros/ha | 15 styro/hr | 27 $/hr | $1980 /ha |
| Packaging: 8kg Styros | 1100 (8kg) styros/ha | | 2.5 $/ctn | $2750 /ha |
| Operation: On farm cartage of styros | 1100 (8kg) styros/ha | | 0.1 $/hr | $110 /ha |
| Processing: Cooling styros | 1100 (8kg) styros/ha | | 0.2 $/ctn | $220 /ha |
| Processing: Ice for styros | 1100 (8kg) styros/ha | | 0.75 $/kg | $825 /ha |
| | | | | **Total Costs: $7865 /ha** |
| **Cartage** | | | | |
| Transportation: Refo pallet | 1100 (8kg) styros/ha | 56 (36L) ctn/pallet | 90.99 $/pallet | $1787 /ha |
| | | | | **Total Costs: $1787 /ha** |
| **Levies** | | | | |
| Commission & Levies | 15 % | | 17600 $/ha | $2640 /ha |
| | | | | **Total Costs: $2640 /ha** |
| | | | | **Total Variable Costs: $20222 /ha** |
| | | | | Gross Margin: -$2,622 /ha |

Effect of Yield and Price on Gross Margin ($/ha)

| Broccoli Yield ((8kg) styros/ha) | $12.80/styro | $14.40/styro | $16.00/styro | $17.60/styro | $19.20/styro |
|---|---|---|---|---|---|
| 770.00 | -$9,205 | -$8,157 | **-$7,110** | -$6,063 | -$5,016 |
| 880.00 | -$8,008 | -$6,811 | **-$5,614** | -$4,417 | -$3,221 |
| 990.00 | -$6,811 | -$5,465 | **-$4,118** | -$2,772 | -$1,425 |
| 1,100.00 | **-$5,614** | **-$4,118** | **-$2,622** | **-$1,126** | $370 |
| 1,210.00 | -$4,417 | -$2,772 | **-$1,126** | $519 | $2,165 |
| 1,320.00 | -$3,221 | -$1,425 | $370 | $2,165 | $3,960 |
| 1,430.00 | -$2,024 | -$79 | $1,866 | $3,811 | $5,755 |

Effects of Yield and Price on Gross Margin per ML (assuming 2.0ML/ha is used).

| Broccoli Yield ((8kg) styros/ha) | $12.80/styro | $14.40/styro | $16.00/styro | $17.60/styro | $19.20/styro |
|---|---|---|---|---|---|
| 770.00 | -$4,602 | -$4,079 | **-$3,555** | -$3,032 | -$2,508 |
| 880.00 | -$4,004 | -$3,406 | **-$2,807** | -$2,209 | -$1,610 |
| 990.00 | -$3,406 | -$2,732 | **-$2,059** | -$1,386 | -$713 |
| 1,100.00 | **-$2,807** | **-$2,059** | **-$1,311** | **-$563** | **$185** |
| 1,210.00 | -$2,209 | -$1,386 | **-$563** | $260 | $1,082 |
| 1,320.00 | -$1,610 | -$713 | **$185** | $1,082 | $1,980 |
| 1,430.00 | -$1,012 | -$40 | **$933** | $1,905 | $2,878 |

## Disclaimer



# Broccoli (Irrigated) Southern Downs 2018

**Gross Margin: -$263 /ha**

QUEENSLAND GOVERNMENT

## Income

| | QTY | YIELD | PRICE | TOTAL |
|---|---|---|---|---|
| Broccoli | | 1100 (8kg) styros/ha | 16 $/styro | $17600 /ha |
| New commodity item | 108 kg | | 24 | $2592 /ha |

**Total Income: $20192 /ha**

## Variable Costs

| | QTY | RATE | COST | TOTAL |
|---|---|---|---|---|
| **Preparation** | | | | |
| Operation: Ripper + FWA Light FORM | 1 operation | 1 ha/hr | 33.93 $/hr | $34 /ha |
| Contract: Labour (hours) | | 4 hr/ha | 27 $/hr | $108 /ha |
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| Irrigation: Hand Shift (FORM) | | 2 ML/ha | 70 $/ML | $140 /ha |
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| Processing: Ice for styros | 1100 (8kg) styros/ha | | 0.75 $/kg | $825 /ha |
| Broccoli seed harvest | 1 | 200 | 1 $/Ha | $200 /ha |
| Broccoli seed grading | 108 | | 0.3 $/kg | $32 /ha |
| | | | | **Total Costs: $8097 /ha** |
| **Cartage** | | | | |
| Transportation: Refo pallet | 1100 (8kg) styros/ha | 56 (36L) ctn/pallet | 90.99 $/pallet | $1787 /ha |
| | | | | **Total Costs: $1787 /ha** |
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| Commission & Levies | 15 % | | 17600 $/ha | $2640 /ha |
| | | | | **Total Costs: $2640 /ha** |
| | | | | **Total Variable Costs: $20455 /ha** |
| | | | | Gross Margin: -$263 /ha |

Effect of Yield and Price on Gross Margin ($/ha)

| Broccoli Yield ((8kg) styros/ha) | New commodity item Yield () | $12.80/styro | $14.40/styro | $16.00/styro | $17.60/styro | $19.20/styro |
|---|---|---|---|---|---|---|
| | | $19.20/ | $21.60/ | $24.00/ | $26.40/ | $28.80/ |
| 770.00 | 0.70 | -$7,363 | -$6,057 | **-$4,751** | -$3,444 | -$2,138 |
| 880.00 | 0.80 | -$6,167 | -$4,711 | **-$3,255** | -$1,799 | -$343 |
| 990.00 | 0.90 | -$4,970 | -$3,364 | **-$1,759** | -$153 | $1,453 |
| 1,100.00 | 1.00 | **-$3,773** | **-$2,018** | **-$263** | **$1,493** | **$3,248** |
| 1,210.00 | 1.10 | -$2,576 | -$671 | **$1,233** | $3,138 | $5,043 |
| 1,320.00 | 1.20 | -$1,379 | $675 | **$2,729** | $4,784 | $6,838 |
| 1,430.00 | 1.30 | -$183 | $2,021 | **$4,225** | $6,429 | $8,633 |

Effects of Yield and Price on Gross Margin per ML (assuming 2.0ML/ha is used).

| Broccoli Yield ((8kg) styros/ha) | New commodity item Yield () | $12.80/styro | $14.40/styro | $16.00/styro | $17.60/styro | $19.20/styro |
|---|---|---|---|---|---|---|
| | | $19.20/ | $21.60/ | $24.00/ | $26.40/ | $28.80/ |
| 770.00 | 0.70 | -$3,682 | -$3,029 | **-$2,375** | -$1,722 | -$1,069 |
| 880.00 | 0.80 | -$3,083 | -$2,355 | **-$1,627** | -$899 | -$171 |
| 990.00 | 0.90 | -$2,485 | -$1,682 | **-$879** | -$77 | $726 |
| 1,100.00 | 1.00 | **-$1,887** | **-$1,009** | **-$131** | **$746** | **$1,624** |
| 1,210.00 | 1.10 | -$1,288 | -$336 | **$617** | $1,569 | $2,521 |
| 1,320.00 | 1.20 | -$690 | $337 | **$1,365** | $2,392 | $3,419 |
| 1,430.00 | 1.30 | -$91 | $1,011 | **$2,113** | $3,215 | $4,317 |

## Disclaimer



# Appendix 2 Potential broccoli plus broccoli seed production supply chain

**Production**

Broccoli is produced all year round in Queensland. Main producing areas are the Lockyer Valley, Granite Belt and Eastern Darling Downs. Hybrid varieties of seedlings and direct seeding is used with maturity approximately 8 weeks after planting. Plant populations range from 36,000 to 75,000 plants /Ha. The immature flower, or broccoli head, is hand harvested by knives into bins when approximately 120 – 150mm in size, before being transported to the packing immediately after harvest. Yields between 7 – 11 tonnes/Ha are normal.


**Marketing and distribution**

Immediately after harvest broccoli is rapidly cooled using vac or hydro coolers. Broccoli is stored for 12 – 24 hours before being packaged into Styrofoam cartons, waxed cartons or reusable retail crates. Most Queensland broccoli is sold domestically through retail supermarkets and greengrocers, wholesale markets and some fresh processors. Approximately 12 % is exported to Asian and Middle East markets.

**Broccoli seed production option**

After harvest broccoli plants are left in the field to flower. Multiple flower stalks appear and flower over an extended periods ( 2 – 8 weeks after fresh broccoli harvest). Bees may be considered for increased pollination.. NB: Many hybrids are not self fertile and polliniser varieties and types may need to be established for synchronised flowering to optimise seed yield. More research is required.

**Seed harvest and grading**

Once broccoli seed has matured it is ready to be harvested (4 – 8 weeks after commencement of flowering). Similar equipment and machinery to canola may be used


**Broccoli seed use**

Seed is collected and graded for delivery to potential markets of sprouting, sprout powder, broccoli seed oil, or seed extract production.