



Evaluation of cauliflower and broccoli varieties

Winter Harvest
(April - August 2007)



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Introduction

This report is the third in a series of four produced from the evaluation of cauliflower and broccoli varieties conducted at the Manjimup Horticultural Research Institute during 2006 and 2007. The results are provided to allow seed suppliers, seedling nurseries, producers, packers and marketers to identify the best variety for a particular harvest period. All varieties receive exactly the same treatment throughout their growth. This has allowed the identification of agronomic requirements that may be specific to some varieties. Varieties that have specific agronomic requirements may perform better when the growing inputs are exactly tailored to suit these varieties. Contact details for participating seed companies are available in Appendix 2.

Trial Details

Transplanting and Harvesting Dates

Table 1: Transplant and harvest dates for cauliflower and broccoli.

	Transplanting Dates	First Harvest Date	Last Harvest Date
Cauliflower	11 April 2007	18 July 2007	10 August 2007
Broccoli	11 April 2007	12 July 2007	18 July 2007

Note: Not all varieties were harvested on every date. These days represent the total harvest days across all varieties.

Transplanting

Cauliflower seedlings were transplanted into a two row per 1.7m bed configuration at a within row spacing of 40cm and a between row spacing of 80cm (29,000 plants/hectare). Broccoli seedlings were transplanted into a three row per 1.7m bed configuration at a within row spacing of 40cm and a between row spacing of 45cm (44,000 plants/hectare). All varieties were grown in 5.1m x 6m plots and were surrounded by a buffer variety. At harvest, 5m of the four inner rows of each cauliflower plot and 3m of the seven inner rows of each broccoli plot were picked, which provided approximately 100 plants for assessment (50 per replicate).

Insect, Disease and Weed Control

A monitoring program for insects and disease was conducted throughout the life of the crop and were controlled as required. Weeds were controlled prior to transplanting and post transplanting.

Weather Conditions

Weather conditions were monitored daily throughout the life of the crop. Details of the weather can be found in Appendix 1. Average maximum daily temperatures were 20.1°C in April, 15.6 in May, 15.1°C in July, 14.3°C in July and 14.2°C in August. Crops were irrigated with over-head sprinklers. Irrigation was scheduled according to 100% evaporation replacement.

Soil Characteristics

The Manjimup Horticultural Research Institute (south western region of Western Australia) is located on red earth soils which consist of a sandy loam surface changing gradually to a red clay subsoil. They are generally porous and well drained with ironstone nodules often present. These soils have a high water holding capacity but are highly weathered and usually deficient in P, N, Zn, Mo and occasionally Cu. High levels of aluminium and iron oxides and a neutral to acid soil pH results in phosphorus being easily fixed in this soil.

Fertiliser Applications

Fertiliser was applied both at transplanting and post transplanting. Details of fertiliser application are given below. All varieties received the same fertiliser program. All nitrogenous products were foliar applied to plants whilst under irrigation to prevent fertiliser burn. Summit Spud® analysis: 6.9% N, 10.2% P, 10.2% K, 8.0% S, 0.15% Cu, 0.16% Zn, 0.9mg Mo, 0.15% Mn, 1.8% Ca. All Phos® analysis: 20.5% P, 1.0% S, 15.0% Ca.

Table 2: Fertiliser application for all varieties.

Date	Product	Rate of Application	Method of Application
11 April 2007	Summit Spud®	1500 kg/ha	Incorporated at planting
11 April 2007	All Phos®	150 kg/ha	Incorporated at planting
14 April 2007	Potassium sulphate	100 kg/ha	Foliar application
14 April 2007	Urea	50 kg/ha	Foliar application
22 April 2007	Urea	50 kg/ha	Foliar application
24 April 2007	Soluble boron	10 kg/ha	Foliar application
24 April 2007	Sodium molybdate	1 kg/ha	Foliar application
24 April 2007	Zinc sulphate	14 kg/ha	Foliar application
28 April 2007	Calcium chelate	1 kg/ha	Foliar application
29 April 2007	Urea	50 kg/ha	Foliar application
3 May 2007	Soluble boron	10 kg/ha	Foliar application
3 May 2007	Zinc sulphate	14 kg/ha	Foliar application
6 May 2007	Urea	50 kg/ha	Foliar application
13 May 2007	Urea	50 kg/ha	Foliar application
20 May 2007	Urea	50 kg/ha	Foliar application
27 May 2007	Potassium sulphate	100 kg/ha	Foliar application
2 June 2007	Calcium nitrate	100 kg/ha	Foliar application
9 June 2007	Calcium nitrate	100 kg/ha	Foliar application
19 June 2007	Calcium nitrate	70 kg/ha	Foliar application
29 June 2007	Calcium nitrate	50 kg/ha	Foliar application (cauliflower only)

Prior to harvest

A visual assessment of vegetative vigour and plant frame was conducted at approximately ten weeks after transplanting. Varieties were given a vigour rating from one to five relative to the vigour of the control variety. Observations on plant frame size and the wrapping ability of the plant (ability of inner heart leaves to self-cover the developing curd) were recorded.

Covering

Curds were manually covered by bending the outer leaves surrounding the curd to form a protective barrier from the sun. This operation was conducted as required to prevent curd discolouration. The number of covers required by each variety in addition to curds covered at harvest was recorded. Curds were covered whenever the curd was visible through the frame or if there was a risk that the curd may have become visible before harvest.

Harvesting

All leaves were removed from around the cauliflower curd and broccoli head during the harvesting procedure so that an accurate estimation of yield (t/ha) could be made. Harvesting occurred every three to four days as required. Harvesting was delayed as long as possible, up to when curd/head quality would decrease if delayed longer. Broccoli was cut so the stem was about the same length as the diameter of the heads, giving an evenly proportioned head width and stem length.

Grading

The cauliflower and broccoli were graded to allow a comparison of their yield and quality to be made. All curds and heads were assessed for total and marketable yield and quality. Marketable yield was determined by the weight of the curd or head, a quality grade score and the density of the curd or head. Colour of the curd and head was also taken into account. A marketable cauliflower curd/broccoli head was considered to be of a high standard of quality (with no visible defects or markings).

An acceptable weight for cauliflower was a curd between 0.5 and 2 kg. The curd should be a round, domed shape and creamy white to white in colour. The quality score must be five or greater and the density score two or greater. An acceptable size for broccoli heads was between 5 and 20 cm in diameter or between 200 and 800 g in weight. The head should be a green colour with no purple tinges. The quality score for broccoli must be five or greater and density score two or greater.

Density scores were allocated according to the following table. The quality scores are not presented in the results as they are used only to separate poor quality curds or heads in the grading data sheets from those that are of a high standard of quality. Varieties that had a large proportion of high quality curds/heads have had this noted in the results section.

Table 3: Density scoring system for cauliflower and broccoli.

Broccoli	Cauliflower
1 = Very open head	1 = Very open curd
2 = Reasonable density (head is closed and floret stems in middle of the head cannot be easily seen)	2 = Reasonable density (florets closed but not very close to stem underneath)
3 = Very tight head (no floret stems in the middle of the head can be seen)	3 = Very tight closed curd (florets curved underneath close to stem)

The number of cauliflower curds/broccoli heads that were considered to meet domestic market specifications was recorded and the percentage of heads from each variety that could be sold on the domestic market calculated.

Storage of Product

Immediately after picking and grading cauliflower curds of a high quality standard were pre cooled to 1°C by forced air cooling, individually wrapped in paper and placed in a cardboard box which was stored at a room temperature of 1°C for 14 days. Broccoli heads of a high quality standard were pre cooled to 1°C by forced air cooling, packed into polystyrene cartons filled with ice and then placed in cool store at 1°C for 21 days. After storage, the curds and heads were removed and re-graded for after-storage quality.

Results

The varieties were assessed prior to harvest, at harvest and post storage. The vigour of varieties was assessed relative to the control variety prior to harvest, at harvest and post storage.

Table 4: Pre-harvest characteristics of cauliflower and broccoli.

Cauliflower variety	Vigour * (1 – 5)	No. of covers required before harvest[^]	Comments[@]
Amsterdam	5	1	Large plant frame. Reasonable wrapping ability.
CLF 4727	5	0	Large plant frame. Good wrapping ability.
Solstice	5	0	Large, open plant frame. Average wrapping ability.
Skywalker - control	5	0	Large plant frame. Reasonable wrapping ability.

Broccoli variety	Vigour * (1 – 5)	No. of covers required before harvest[^]	Comments
BRC 7680	4	na	Medium to large plant frame. Head sits high in frame and has large beads.
BRC 7681	5	na	Large plant frame. Head sits low in frame and has fine beads.
TBR 7797	4	na	Medium to large plant frame. Head sits reasonably high in frame and has fine beads.
TBR 7798	4	na	Medium to large plant frame. Head sits high in frame with medium sized beads.
Leyton	3	na	Small plant frame. Head sits low in frame and has fine beads.
Ironman - control	4	na	Small to medium plant frame. Head sits high in frame and has large beads.

* 1 = low vigour (less growth)
5 = high vigour (greatest growth)

[^] The number of covers prior to harvest indicates those varieties that require covering in addition to the covering procedure carried out during harvest.

[@] Wrapping ability refers to the ability of inner heart leaves to self-cover the developing curd from exposure to the sun.

Table 5: Maturity times, spread of harvest and total and marketable yield of cauliflower and broccoli at harvest.

Cauliflower variety	Days from transplant to first harvest[^]	Number of picks required (total yield)	Total Yield (t/ha)*	Marketable Yield (t/ha) #	Number of marketable curds per hectare @
Amsterdam	98	2	21.7	15.0	24,412
CLF 4727	111	3	21.1	18.0	26,765
Solstice	118	2	16.3	12.8	25,294
Skywalker - control	111	3	21.3	20.0	28,824

Broccoli Variety	Days from transplant to first harvest[^]	Number of picks required (total yield)	Total Yield (t/ha)*	Marketable Yield (t/ha) #	Number of marketable heads per hectare @
BRC 7680	92	2	14.9	11.8	32,773
BRC 7681	92	2	13.9	11.0	35,714
TBR 7797	92	2	12.2	10.0	34,034
TBR 7798	92	2	14.4	13.5	38,656
Leyton	92	2	15.4	15.3	41,177
Ironman - control	92	2	15.5	12.2	31,933

[^] Days from transplant to first harvest have been averaged for the two replicates of each variety.

* Yields may be greater in trials than commercial practice due to all curds being picked. Curds that mature early or late compared to the main harvest period may not be included in commercial yield estimates.

Yield when curds/heads not suitable for market are removed.

@ Number of heads suitable for domestic market sale out of an original 29,000 plants per hectare planting density for cauliflower and 44,000 plants per hectare planting density for broccoli

Table 6: Characteristics of cauliflower and broccoli at harvest.

Cauliflower variety	Average marketable curd weight (g)	Average marketable curd diameter (cm)	Density[^]	Colour[*]
Amsterdam	738.9	15.6	2.1	White
CLF 4727	772.7	14.4	2.8	Off white
Solstice	648.2	13.9	2.4	White
Skywalker - control	746.0	14.0	2.9	Off white

Broccoli variety	Average marketable head weight (g)	Average marketable head diameter (cm)	Density[^]	Colour
BRC 7680	369.3	13.9	1.9	Green
BRC 7681	378.5	13.3	2.3	Light green
TBR 7797	351.3	13.1	2.4	Green
TBR 7798	364.8	13.0	2.6	Light green
Leyton	372.7	13.4	2.8	Light green
Ironman - control	395.2	13.9	2.0	Green

[^] Average density of total yield.

^{*} Off white describes a curd that has a slightly creamy colour although it is predominately white.

Table 7: Percentage (%) of total yield picked at each harvest*.

Cauliflower variety	18 July (98)	24 July (104)	31 July (111)	3 August (114)	7 August (118)	10 August (121)	Total
Amsterdam	41	59					100
CLF 4727			27	34	39		100
Solstice					56	44	100
Skywalker - control			32	16	52		100

Broccoli variety	12 July (92)	18 July (98)	Total
BRC 7680	46	54	100
BRC 7681	3	97	100
TBR 7797	5	95	100
TBR 7798	5	95	100
Leyton	47	53	100
Ironman - control	26	74	100

* The percentage of yield picked at each harvest has been averaged for the two replicates of each variety.

() Figure in brackets represents the number of days from transplanting to first harvest.

Table 8: Cauliflower curd and broccoli head comments

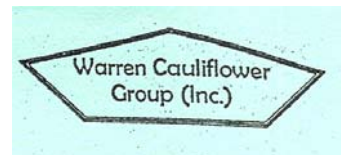
Cauliflower variety	Comments (Harvest)	Comments (Post-storage)*
Amsterdam	Reasonable harvest quality. Reduction in marketable yield due to low density and yellow curds.	Loss of post storage quality due to reduction in curd firmness.
CLF 4727	Good harvest quality. Minor reduction in marketable yield due to reduced curd size and low density curds.	Minor loss of post storage quality due to reduction in curd firmness.
Solstice	Reasonable harvest quality. Reduction in marketable yield due to reduced curd size and yellowing.	Very good post storage quality. Minor reduction in curd firmness.
Skywalker - control	Good harvest quality. Minor reduction in marketable yield due to presence of some off-types and furry curds.	Excellent post storage quality.
Broccoli variety	Comments (Harvest)	Comments (Post-storage)*
BRC 7680	Reasonable harvest quality. Marketable yield reduced by an uneven dome shape and purpling.	Minor loss of post storage quality due to reduction in head firmness.
BRC 7681	Reasonable harvest quality. Marketable yield reduced by the presence of leaves in the head.	Minor loss of post storage quality due to reduction in head firmness.
TBR 7797	Reasonable harvest quality. Marketable yield reduced by presence of leaves in the head and uneven beading.	Very good post storage quality. Minor yellowing of beads on one head.
TBR 7798	Good harvest quality. Minor reduction in marketable yield due to presence of leaves in the head and some off-types.	Very good post storage quality.
Leyton	Very good harvest quality.	Good post storage quality. Minor yellowing of beads.
Ironman - control	Good harvest quality. Marketable yield reduced by low density heads and the presence of off-types.	Excellent post storage quality.

* Collapse is the breakdown of individual 'flowers' within a floret. Discolouration of the affected 'flowers' has not yet occurred. Deterioration is the next stage from cell collapse, when the individual 'flowers' have started to turn brown or black.

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- *Rijk Zwaan*
- *Springall Nursery*
- *Syngenta*
- *Terranova Seeds*
- *Warren Cauliflower Group (Inc)*



Appendix 1

Weather records at Manjimup Horticultural Research Institute (April – August 2007)

Monthly weather summary – April 2007

Date	Temperature		Evaporation mm	Rain mm	Comment
	Max	Min			
1-Apr-07	20.9	11.3	2.7	4.0	Showers, warm
2-Apr-07	16.9	13.2	1.8	0.8	Cloudy, mild
3-Apr-07	22.4	12.4	3.2	0.2	Fine, warm
4-Apr-07	26.9	13.2	4.9	0.0	Fine, warm
5-Apr-07	27.6	16.6	5.1	0.0	Fine, hot
6-Apr-07	28.0	13.0	3.6	0.0	Fine, hot
7-Apr-07	24.1	12.2	4.1	0.0	Cloudy, warm
8-Apr-07	24.5	12	3.4	3.4	Showers, warm
9-Apr-07	15.4	9.2	2.1	2.2	Overcast, mild
10-Apr-07	15.0	9.5	1.3	0.0	Overcast, mild
11-Apr-07	18.9	12.5	2.8	0.2	Fine, warm
12-Apr-07	22.0	10.5	2.9	0.0	Fine, warm
13-Apr-07	23.7	13.1	4.2	0.0	Cloudy, warm
14-Apr-07	20.3	15.2	1.5	0.0	Cloudy, warm
15-Apr-07	23.4	14.5	2.9	11.4	Widespread showers, warm
16-Apr-07	16.2	9.1	0.3	19.0	Drizzle, mild
17-Apr-07	16.2	9.5	1.9	0.2	Overcast, overnight showers, mild
18-Apr-07	17.5	10.5	1.7	2.6	Cloudy, mild
19-Apr-07	16.8	6.0	3.1	0.2	Cloudy, mild
20-Apr-07	17.1	10.5	1.8	0.4	Cloudy, mild
21-Apr-07	17.0	9.5	1.4	2.4	Fine, mild
22-Apr-07	20.2	10.1	2.9	0.0	Thundery showers, warm
23-Apr-07	20.6	11.4	2.0	3.0	Partly cloudy, warm
24-Apr-07	22.4	11.7	2.5	0.4	Showers, warm
25-Apr-07	16.9	8.0	1.4	5.4	Overcast, overnight showers, mild
26-Apr-07	15.2	6.2	2.0	0.0	Fine, mild
27-Apr-07	18.2	7.8	3.2	0.2	Cloudy, mild
28-Apr-07	19.0	8.7	3.1	0.0	Windy, cloudy, mild
29-Apr-07	18.9	13.1	2.7	0.0	Windy, mild
30-Apr-07	19.4	9.6	1.6	14.8	Showers, mild

Monthly weather summary – May 2007

Date	Temperature		Evaporation mm	Rain mm	Comment
	Max	Min			
1-May-07	14.7	9.6	0.6	18.8	Showers, mild
2-May-07	14.2	11.6	0.7	3.4	Drizzle, mild
3-May-07	14.8	9.2	1.5	0.0	Cloudy, overnight showers, mild
4-May-07	16.7	13.3	1.9	2.6	Showers, mild
5-May-07	17.2	12.7	1.1	5.6	Overcast, mild
6-May-07	15.7	8.2	0.9	0.2	Drizzle, mild
7-May-07	15.4	10.2	1.4	1.6	Cloudy, mild
8-May-07	15.5	6.2	1.9	0.2	Fine, mild
9-May-07	18.6	9.6	2.6	0.0	Fine, mild
10-May-07	21.7	12.6	3.4	0.2	Fine, warm
11-May-07	23.7	13.8	3.4	0.0	Overcast, warm
12-May-07	15.9	12.1	0.0	0.2	Overcast, mild
13-May-07	16.1	10.3	1.5	3.2	Showers, mild
14-May-07	12.9	7.4	1.1	0.0	Drizzle, cool
15-May-07	12.3	8.9	1.0	0.0	Overcast, cool
16-May-07	15.1	8.9	1.2	0.0	Overcast, drizzle, mild
17-May-07	14.0	7.8	0.9	0.0	Cloudy, cool overnight, rain
18-May-07	16.3	7.7	1.5	9.2	Cloudy, mild
19-May-07	12.9	6.1	1.3	0.0	Showers, cool
20-May-07	14.3	8.8	1.5	6.2	Overcast, mild
21-May-07	13.5	5.7	1.5	0.0	Cloudy, cool
22-May-07	14.0	8.6	1.3	0.0	Mild
23-May-07	17.3	11.6	2.1	0.4	Mild
24-May-07	16.1	12.6	1.2	0.8	Mild
25-May-07	17.7	13.0	1.6	0.4	Mild
26-May-07	18.4	10.5	1.5	8.2	Cloudy, mild
27-May-07	13.1	8.2	1.1	1.6	Heavy overnight showers, cool
28-May-07	11.7	8.0	0.4	30.4	Showers, cool
29-May-07	12.9	7.1	1.1	0.0	Overcast, cool
30-May-07	13.9	8.2	0.9	0.0	Cloudy, cool, overnight rain
31-May-07	17.1	8.8	1.4	0.0	Fine, mild

