

Brassica information kit

Reprint – information current in 2004



REPRINT INFORMATION – PLEASE READ!

For updated information please call 13 25 23 or visit the website www.deedi.qld.gov.au

This publication has been reprinted as a digital book without any changes to the content published in 2004. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Chemical recommendations—check with an agronomist or Infopest www.infopest.qld.gov.au
- Financial information—costs and returns listed in this publication are out of date. Please contact an adviser or industry body to assist with identifying more current figures.
- Varieties—new varieties are likely to be available and some older varieties may no longer be recommended. Check with an agronomist, call the Business Information Centre on 13 25 23, visit our website www.deedi.qld.gov.au or contact the industry body.
- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available for each crop. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

This publication was last revised in 2004. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.

This information has been made available to assist users to identify issues involved in brassica production. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

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Queensland Government

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Queensland Government



Common QUESTIONS

Chapter

This chapter contains the most commonly asked questions about growing cabbage, cauliflower and broccoli. Where the word brassicas is used, it includes all three crops unless they are mentioned separately. The answers are as brief as possible. Where this is difficult and more detail is required, we refer you to other sections of the book. Symbols on the left of the page will help you make these links.

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Varieties

What's the best variety to plant?

Almost all brassicas grown in Queensland are hybrid varieties. The variety you choose depends on planting time, the expected growing conditions and the preferences of the target market for which you are producing. No single variety performs well across all seasons or districts and choosing the right variety for the district and season can be a complex decision.

In the Lockyer Valley, Warrior was the main cabbage variety grown during the 2002 and 2003 seasons. The broccoli variety, Babylon has largely superseded Greenbelt for main season planting. Escale and Discovery were the preferred main season cauliflower varieties.

In the highland areas, Kameron and Warrior were the main cabbage varieties planted. Atomic (Viper) was a popular choice for summer broccoli and Cauldron, Charlotte and Fremont were the main cauliflower varieties grown. Various other varieties were used for early and late season production in the two districts.

Seed companies, seedling producers, other brassica growers, and local agricultural suppliers and consultants are valuable sources of information on choosing varieties.

Seed companies regularly release new varieties. We recommend that you make small plantings of promising new varieties for trial alongside standard varieties before planting larger areas.

Planting

What is the best time of year to grow brassicas?

Cool, sunny days with temperatures between 15° and 25°C and night temperatures between 10° and 15°C are considered ideal. In most regions of southern Queensland, this means production is limited to March through to October, as only the elevated areas around Toowoomba and Stanthorpe have the cool conditions necessary to produce quality summer brassica crops.

Should I use transplants or direct seed the crop?

In Queensland, the majority of brassica crops are established using transplants. Transplants are normally produced as container grown seedlings by a commercial seedling nursery or on-farm. Direct seeded crops cost less to establish but mature up to two weeks later than seedlings planted out at the same time. Problems with soil crusting, weather, weed control, soil disease and insects can severely reduce crop stands in direct seeded crops.



Varieties
Chapter 4 page 127

More detailed information about planting can be found in
Decide when to plant
Chapter 3 page 34
and *Before you start*
Chapter 1 page 2

a key issue



Decide to transplant or direct-seed
Chapter 4 page 145

If you are growing brassicas for the first time, use transplants produced by a commercial seedling nursery to establish the crop.

What is the optimum plant spacing?

The planting arrangement and subsequent planting density depends on the equipment available, variety grown, the head size required, season and local growing conditions.

more info



Row width and plant spacing
Chapter 3 page 40

The majority of broccoli is grown in two or three rows per raised bed with 300 to 400mm between plants in the row. Cauliflower and cabbage are often grown in double rows on raised beds or sometimes in single hilled rows, with 600 to 700mm between plants in the row. Distance between bed centres is usually 1.5m. Distance between centres of single hilled rows is usually 0.9m.

more info



Calculate the number of plants needed
Chapter 3 page 40

Where do I buy transplants and how many do I need?

Numerous seedling nurseries grow transplants for sale. Check the Yellow Pages for nurseries that supply transplants for the vegetable industry. The *Contacts & references* chapter gives contact details for the two major seedling nurseries in south-east Queensland. Once you have decided on plant spacings and bed arrangements it is possible to calculate how many plants you will need to order from the nursery. Order transplants several months before the expected planting date.

Pests and diseases

What are the main pests?

Diamondback moth (DBM) and to a lesser degree, heliothis are the two most important pests of brassicas but other caterpillar pests, aphids, thrips and silverleaf whitefly can also cause problems.

During the first three to four weeks after planting, centre grub and cutworm are the most likely pests to cause damage in summer and autumn planted crops. Other caterpillar pests, thrips and silverleaf whitefly may also be active during crop establishment. Aphids can cause problems in seedlings, particularly during warm, mild conditions.

Once the crop is established, DBM, heliothis, cabbage cluster caterpillar and cluster caterpillar, cabbage white butterfly, thrips and silverleaf whitefly are all likely problems.

Hares, wallabies, kangaroos and ducks are only occasional pests of brassicas but they can cause significant damage. Feeding mice can damage broccoli and cauliflower heads.

I'm having trouble controlling grubs in my crop. What has gone wrong?

Poor spray application, poor timing of spray applications, wrong chemical for the insect problem, year round or hot weather production, insect resistance to chemicals used and over-reliance on chemicals as the only control option—these can all be factors in poor control of grubs in brassica crops.

Make sure that you identify the pest correctly so that you can select the most effective insecticides for the pest problem. Check that spray equipment is giving good spray coverage of plants and regularly calibrate spray equipment. Avoid warm weather production as insects are more difficult to control in hot temperatures. Rotate insecticides from different chemical groups to prevent or overcome chemical resistance in the pest. Large grubs are hard to kill—apply sprays while caterpillars are still small. Do not grow brassica crops year round.

Try using an integrated pest management (IPM) approach to control pest problems in the crop. IPM combines a wide range of management tactics to prevent pests and diseases causing economic crop damage. It involves regular crop monitoring to ensure that chemical sprays are only used when necessary therefore encouraging natural enemies of pests into the crop. IPM also uses preventative management strategies, such as crop rotations and production breaks to minimise the risk of pest and disease problems. Because IPM requires in-depth knowledge of the crop and its pests we recommend that first time growers use a crop consultant.



IPM principles
Chapter 4 page 183

When should I spray to control insect pests?

You have two choices. You can spray according to the calendar, for example, by spraying every two weeks even if there are no pests present, or you can spray only when there is a pest problem in the crop as part of an integrated pest management (IPM) program.

The first option—spraying by the calendar is likely to lead to chemicals being applied that are not needed which is expensive and may adversely impact on the environment. It also exposes the crop to greater risk of pest outbreaks and insecticide resistance problems.

The second option—IPM is the preferred choice as management decisions are based on what is actually happening in the crop. The crop is regularly monitored for insects and diseases (at least once a week), to check if any action is necessary. It requires a significant amount of experience and knowledge to make the correct decision on whether to spray or not. We recommend you employ a professional crop consultant to assist with this decision making process.

Articles in Chapter 4 of this book provide information about the main insect pests and diseases you are likely to find in your crop. We also provide basic guidelines on how to monitor crops to help you use an IPM program effectively.

Which sprays won't affect the natural enemies in the crop?

Narrow spectrum insecticides such as *Bacillus thuringiensis* can be used to control caterpillars with little adverse effects on natural enemies. To get a good result it is important to spray caterpillars when they are still small. There are several other insecticides available that are specific to particular pests and have a reduced impact on natural enemies. The label on the chemical container will usually include some information on the chemical's impact on natural enemies.



Natural enemies
Chapter 4 page 218

Synthetic pyrethroids, carbamates and most organophosphates are considered broad-spectrum insecticides and will kill a range of insects, some of which may be beneficial.

What diseases are important?

Soil borne diseases such as club root, damping off, wirestem, sclerotinia rot, black leg, yellows and sclerotium base rot can survive in the soil for long periods. Club root is potentially the most devastating but its distribution within Queensland appears limited to the Granite Belt district. Sclerotinia rot can rapidly rot stems, leaves and heads, causing wilting and then collapse of the plant. Damping off and wirestem are primarily a problem in seedlings and during crop establishment. Good soil preparation, farm hygiene and the use of appropriate crop rotations are essential in controlling these soil borne diseases.

Bacterial leaf and head diseases usually cause the most problems in brassica crops. They include black rot and leaf scald, peppery leaf spot, zonate leaf spot and bacterial head rots. Black rot and bacterial head rots are common and often serious diseases during warm, wet weather. Hot water treatment of seed, crop rotations and farm hygiene all have a part to play in controlling these diseases. Proper cooling and low temperature storage of produce will reduce bacterial head rot problems.



Disease management
in the field
Chapter 4 page 223

Fungal leaf diseases include downy mildew, ring spot, alternaria spot (target spot) and grey mould. Downy mildew can be a serious problem in seedling nurseries as crowding of plants provides the ideal conditions for the disease to develop. It is usually less of a problem after transplanting.

What is causing the roots to swell up?

Swollen roots and stunted plants that wilt during the middle of the day are likely to indicate club root infection. Be careful not to break any of these roots off and drop them onto 'clean' soil. Contact the DPI&F for assistance, quarantine the affected area but don't remove samples from your crop.

CLUBROOT

Don't ignore any symptoms you think may indicate clubroot—the earlier the disease is detected, the easier it will be to manage.

Photos and what to do about the problem can be found in the companion book available from DPI&F offices—
 PICTURE GUIDE: *Brassica problem solver and beneficial identifier*

What should I do if I find club root?

Don't panic! There are infested farms which continue to grow crops while managing the problem. Contact your local DPI&F for advice and support. The fear of becoming a known club root infected property is far worse than the eventuality.

How do I prevent club root from appearing on my property?

There are several things you can do and they all centre on farm hygiene. Limit the traffic on your farm particularly into production areas. Put up signage to show that you are serious about restricting entry to your farm. Look out for possible sources of contamination—infected transplants, dirty machinery, vehicles, bins and boots, contract labour and other visitors to the farm. Don't lend equipment and machinery without accepting that this increases the risk of infecting your farm with contaminated soil. Provide facilities for washing down equipment, vehicles and footwear. Don't allow people to enter your property unless they remove contaminated footwear.

What is causing the heads to rot?

During warm, wet weather broccoli is particularly prone to bacterial head rots, a result of infections by the bacteria *Erwinia* and *Pseudomonas*. The slimy, soft rot can affect heads in the field and after harvest and is accompanied by a characteristic foul smell. Infection occurs through injuries of plant tissue.

In cabbage, sclerotinia head rots caused by the fungus *Sclerotinia sclerotiorum* are more likely to occur. Cool, wet weather favours this disease.

In cauliflower, both sclerotinia and bacterial head rots can be a problem. *Alternaria* spot caused by the fungus *Alternaria brassicicola* is also a possibility.

What is causing the yellowish-brown, dead areas on the leaves?

The most likely problem is black rot, a bacterial disease, which causes yellowish-brown v-shaped symptoms around leaf edges. Bacterial diseases are common in extended showery and windy weather. The bacteria invade leaf tissue through wounds or tiny natural leaf openings such as hydathodes and stomata and then multiply very rapidly—symptoms often appearing soon after rain.

Bacterial diseases such as black rot, leaf scald, zonate leaf spot and peppery leaf spot can quickly become serious problems in wet weather. There are no registered chemicals available to prevent disease development once infection has occurred and it is difficult to apply effective protective sprays during rainy conditions.

How do I get started with integrated pest management (IPM) for controlling pests and diseases?

There is no recipe for IPM but a critical first step is to switch from routine chemical sprays to strategic sprays based on crop monitoring results. We recommend you employ a crop consultant to help you get started with IPM. If a professional crop consultant is not available in your area, monitoring the crop yourself or training one of your staff is an option—this approach requires commitment and time. Learn as much about the different pests, diseases and weeds as you can and take part in any field days or training activities on pest management that may be available.

- IPM aims to work with nature rather than against it by using preventative strategies such as crop rotations, production breaks and farm hygiene to reduce pest and disease problems.
- IPM relies on regular crop monitoring to keep track of what is happening in the crop, selecting the right strategy for managing a problem and then checking that the management option has worked. Sprays are seen as only one option in a range of management strategies available.
- To encourage and protect natural enemies, low levels of crop damage are tolerated and ‘soft’ or narrow-spectrum chemicals are preferred when selecting a spray option.



An integrated approach
(IPM)
Chapter 4 page 183

Weeds

I've got weeds in my brassica crop. How do I get rid of them?

If they are grass weeds, there are several post-emergence herbicides you can use. Fluazifop-P, sethoxydim, quizalofop-P-ethyl, quizalofop-P-tefuryl and clethodim are selective herbicides that kill grass weeds but will not affect the crop. Make sure you follow the label recommendations and observe the withholding period.

If your problem is broadleaf weeds, there are currently no herbicides registered for post-emergence use. If the crop is small but well established, mechanical cultivation may be an option. Otherwise hand-weeding is the only practical alternative.

An integrated approach to weed control to reduce the weed seed bank is essential. This includes crop rotations, soil cultivations and pre-irrigation to germinate weed seeds prior to planting. These weeds can then be killed with non-selective herbicides or mechanical cultivation prior to planting the crop

Never allow weeds to set seed.



Managing weeds
Chapter 4 page 237

Agrilink kits for lettuce and potato are available from DPI&F Publications. See Chapter 5 page 290 for contact details.

If you suspect herbicide damage, check for matches between the symptoms you observe and photographs of damage in the companion book, PICTURE GUIDE: *Brassica problem solver and beneficial identifier*

How do I decide which pre-emergence herbicide I use?

Six different active ingredients are registered for pre-emergence weed management in brassicas. Herbicide choice will depend on the planting method; the weed species likely to be a problem; the relative costs of application; the following crops in the rotation and the types of herbicides used in previous crops.

My problem with fat hen seems to be getting worse. What can I do about it?

It is likely that you have been using the same herbicide, such as metolachlor, for many years. Using the same herbicide continuously often results in a build-up of problem weeds. In this instance, a switch to oxyfluorfen or pendimethalin should provide better management of fat hen.

Following a lettuce or potato crop, I often have problems with sowthistle in my brassica crop. What can I do?

The first step is reduce sowthistle seedset in these previous crops. Strategies for achieving this are detailed in the Agrilink information kits for these crops. In the brassica crop, you will probably need to use the highest registered rate of pre-emergence herbicides that are safe to use as sowthistle is only moderately susceptible to most of the registered herbicides.

I don't want to use herbicides to control weeds. What are my options?

Even where herbicides are used, it is important to integrate them with other weed management practices. Controlling weeds is really about long-term management—by minimising seedset in previous crops, reducing weed seed and preventing weed emergence or killing weeds at all stages of crop growth. Apart from the three most commonly used control practices of mechanical cultivation, hand-weeding or spraying herbicides, techniques such as flaming, mulching, fumigation or solarisation can be tried.

I think the pre-emergence herbicide has damaged the crop. Why has this happened?

Firstly, make sure it *is* herbicides causing your problem. Root or leaf diseases, poor planting techniques, insect damage, nutrient deficiencies or toxicities or inclement weather can cause symptoms similar to herbicide damage.

Check your application practices. Contamination from previous spraying operations, incorrect calibration or double spraying will obviously cause problems. The margin for safety between good weed control and crop damage for most of the registered herbicides is not great. Most of

these products should be used at lower rates on sandy soils. There are also different sensitivities to herbicides amongst the brassica vegetables and even between varieties.

Using spray chemicals

Why did the chemical spray fail to fix the problem?

Use a process of elimination to work out why the spray may have failed.

- Did you achieve good plant coverage? Poorly maintained and calibrated application equipment will not deliver the chemical to where it is needed. Some other factors are: insufficient water volumes (not chemical rate!) used to give good crop coverage; droplet size produced by spray equipment too large or too small; spraying in the middle of the day in hot conditions, spraying on windy or very still days. Some light air movement is needed to move droplets into the crop canopy.
- Did you select the right chemical for the job? Correct identification of the problem is essential as chemicals are only effective against specific insect or disease problems.
- Did you time the spray application to target the most susceptible stage of the pest's lifecycle? Large grubs are hard to kill—time sprays to target small caterpillars.
- Did you use the right chemical rate? If you tank-mixed different chemicals, are they compatible? Check the product label for information on application rates and product compatibility.
- Is the chemical still active? Store in a cool, dry place and check the chemical's use-by date.
- Is the pest resistant to the chemical? There are high general insecticide resistance levels in diamondback moth and heliothis in most production districts. Do not re-spray the crop with an insecticide from the same chemical group. Do not overuse insecticides from the one group but rotate amongst chemical groups.
- If you are attempting to control a high insect population, several well-timed sprays may be needed to control the pest outbreak.
- If you are having problems controlling a bacterial disease, limited chemical options and difficulty in keeping protectant chemicals on leaves in wet weather will make control difficult.

What is the best spray equipment to use?

Hydraulic boom sprayers are commonly used for spraying brassicas, with air assisted hydraulic boom sprayers becoming more popular in the last few years. Buy spray equipment that suits your situation and budget.



Effective spray application
Chapter 4 page 244

The procedure for calibrating a conventional boom sprayer is provided in the section on *Effective spray application* in Chapter 4 page 253.

Select equipment based on its ability to give good crop coverage. Make sure that the sprayer is set up correctly, is well-maintained and regularly calibrated.

How do I calibrate my spray equipment?

Calibrating spray equipment involves measuring the output from each jet/nozzle, working out the volume of water applied per hectare and calculating the pesticide that needs to be added to the spray tank to give the correct application rate per hectare.

What is an MRL?

Maximum Residue Limit (MRL) is the maximum level of a chemical permitted to be present in a food. It is expressed as milligrams of chemical per kilogram (mg/kg) of the food. Produce at the markets is randomly tested for pesticide residue. Farmers have been prosecuted when chemical residues were found above the MRL, or residues of non-registered chemicals were found.

What is a withholding period (WHP)?

The withholding period is the number of days that must pass between the last chemical application and harvest; or for post harvest treatments, the number of days from treatment to consumption. It will be found on the chemical label.

Residues should be below the MRL if the chemicals are used at the registered rate and frequency and the withholding period is observed.

Do I need training in the safe use of chemicals?

In Australia, restricted chemicals can only be supplied to or used by, an authorised person. An authorised person is one who conducts the business of selling or supplying agricultural chemical products, or is a state licensed spray contractor, or is certified by ChemCert Australia. In some states you cannot buy chemicals unless you have a current spray accreditation.

Currently, by law in Queensland, you only need training in safe use of chemicals if you are a contractor spraying on other people's land or you want to buy restricted chemicals. However, most customers now see it as highly desirable for their growers to be able to demonstrate safe, responsible use of chemicals. One of the best ways to demonstrate this is to obtain a ChemCert accreditation.

Freshcare, SQF 2000^{cm}, ISO 9002 + HACCP and supermarket Quality Management Standards require at least one person in the business (usually those involved in supervision of chemical use) to be accredited through an approved ChemCert course.



See *Quality assurance questions* page 104

The ChemCert Australia website has a training calendar for each state that will let you see when a course is being run near you. See *ChemCert* contacts in Chapter 5 page 279 or visit the website www.chemcert.org.au



Safe storage, use and disposal of pesticides
Chapter 4 page 256

How do I get spray accreditation?

ChemCert Australia is a non-profit organisation which provides and supports this training and accreditation program through the state ChemCert organisations.

Every state has its own ChemCert organisation responsible for delivering training. In Queensland this is ChemCert Training Queensland Inc. Most courses run for one or two days with a cost to cover the training, resource manuals, assessment and administration. Training and assessment procedures are based on endorsed national competency standards and conducted only by qualified, trained and accredited instructors working through a Registered Training Organisation.

Accreditation is valid for 5 years with the expiry date shown on the Accreditation Card. To renew Accreditation after five years, participants must undergo one of ChemCert's reaccreditation training and assessment options.

How should I store my chemicals?

Chemicals need to be stored in accordance with the AS2507-1998 standard. This does not mean you will have to spend a fortune on elaborate storage facilities. You do, however, need to be aware of several safety, environmental and food safety factors whenever you deal with chemicals.

Information on correct storage of chemicals is covered in the ChemCert accreditation course. Employees of farm chemical resellers with Agsafe accreditations, which specifically relates to the handling, storage and transport of chemicals are also a useful source of information.

Do I need to keep a diary of spraying records?

Yes, you do! Records of chemical application are now one of the most important pieces of documentation you will need to be able to prove what you have done with chemicals. Most merchants and agents supplying the retail sector now expect you to keep spray records showing at least what was applied, how much, by whom and when the application took place.

Fertiliser

What fertilisers do I need?

A fertiliser application program should be based on the results of a complete soil analysis taken at least eight weeks before the intended planting date. Results from this analysis will also indicate if lime or dolomite is needed to increase the soil pH. Ideally, these products should

be applied two or three months before planting, or when the previous crop or cover crop is incorporated.

Depending on the fertility of the soil, an establishment fertiliser containing nitrogen, phosphorous and potassium is usually applied at or just before planting. Supplementary side-dressings of nitrogen, sometimes potassium, may be required. These should be split into several applications with all fertiliser applied before heads start to form. It is standard practice to apply foliar sprays of boron and molybdenum early in the crop's growth in districts where deficiencies to these nutrients are common.



a key issue

Nutrition
Chapter 4 page 152

What is the difference between leaf and sap analyses?

Leaf analysis is a bench-marking tool that has little direct impact on the current crop. It measures the percentage of nutrient that has accumulated in the leaf and provides information on how well the crop has been grown up to that point. Its value is in assessing the fertilising schedule of the current crop and how it may be improved for subsequent crops. Optimum leaf nutrient levels for cabbage, cauliflower and broccoli are well established.

Sap analysis is a means of rapidly assessing a plant's current nutrient status. It can be used to highlight deficiencies of essential elements or to monitor the nitrate and potassium levels during the crop cycle. Sap testing can allow growers to adjust the fertiliser regime in the current crop and to correct any nutrient problems before yield or quality is affected. The flow of nutrients in sap is sensitive to factors other than nutrient supply so care should be taken in interpretation of results.

Irrigation

What water quality can I use?

Brassicas are moderately tolerant of saline irrigation water, with broccoli more tolerant than cabbage or cauliflower. Brassicas should be irrigated with water that has an electrical conductivity (EC) of less than 1.7 dS/m (deciSiemens per metre). Irrigation water with an EC higher than this may reduce yields and cause damage under difficult growing conditions such as hot dry windy weather.

How much water do brassica crops need?

Brassica crops need between 2.5 to 4.0 megalitres (ML) of water per hectare of crop as either rain or irrigation. Brassicas are shallow rooted crops. Most of the roots are in the top 35 cm of soil and readily available soil moisture should be kept in that zone. The irrigation system must be capable of uniformly delivering the required amounts of water on



more info

Water testing labs
Chapter 5 page 281

demand, when the crop requires it. This can be up to twice per week during establishment.

How do I know when to irrigate and how much to apply?

Adequate watering during the first few weeks after planting is critical for crop establishment and any water stress at this stage will affect the yield and quality of the final product. In the first three weeks after transplanting apply light irrigations (10 to 15mm) once or twice per week, depending on the weather. For direct sown crops, irrigate in this way for about 5 weeks after seedling emergence.

Once the crop is established the amount and timing of irrigation should be based on a soil moisture monitoring system such as tensiometers. Tensiometers measure the moisture status of the soil and allow irrigation to be timed to actual crop needs rather than an estimate of weather and soil conditions.

It is important that the irrigation system is capable of delivering water uniformly at the frequency and rate needed to meet the requirements of the crop.



a key issue

Irrigation management
Chapter 4 page 168

Harvesting and postharvest handling

When is the crop ready for harvest?

Check with your seedling supplier or seed company representative on the number of days to harvest for each variety planted. This information will help in estimating the harvest date. If the weather is cooler than expected, the crop will take several days longer to mature. If it is warmer than expected, the crop may mature several days earlier than your estimated harvest date.

Typically cabbage and cauliflower mature between 10 to 12 weeks after transplanting in warm weather and 12 to 14 weeks in cool conditions. Broccoli matures a little faster than cabbage and cauliflower. Closely monitor your crop in the lead up to the estimated harvest date to ensure that harvesting begins at optimum crop maturity.

What yields can I expect?

Yields vary significantly with season and plant population.

For broccoli, an average yield range of 900 to 1000 icepacks per hectare would be expected with a plant population of 40 000 plants per hectare. In warm or wet weather, average yields can decrease to 700 icepacks or less per hectare.

For cauliflower, yields range from 1500 to 2000 cartons per hectare depending on planting density, cut out rates and heads packed per



more info

Weeks to harvest and
Assessing maturity
Chapter 3 pages 39, 61

carton. Cauliflower is particularly sensitive to temperature fluctuations and inclement weather.

For drumhead cabbage, an average yield of 16 000 heads per hectare would be expected on a planting density of 20 000 plants per hectare. Yields would be lower for crops grown under warm or wet temperatures or adverse weather conditions.

How do I pack cabbage, cauliflower or broccoli?

Industry wide grade standard regulations for broccoli, cabbage and cauliflower no longer apply. The grading standards you use should be negotiated with your agent, merchant or buyer.



Packing
Chapter 3 page 167

Packaging for brassicas varies depending on the product and the market. For broccoli, two types of packages are commonly used, either waxed fibreboard vegetable cartons or polystyrene 'coffin' icepacks. Modified atmosphere bags can be used in unwaxed fibreboard cartons (along with pre-cooling) to extend shelf life. Some supermarkets require broccoli to be packaged using these bags. Cabbages and cauliflowers can be packed either in waxed vegetable cartons or in bulk bins, depending on customer requirements. Check with your wholesaler on preferred packaging for different markets.

Do I need to cool the produce?

Broccoli is highly perishable and pre-cooling to 0° to 2°C, starting within one hour of harvest, is essential. Forced-air cooling is the most common method of removing field heat quickly, but hydrocooling is also an option. Broccoli will store for two to three weeks at 0°C and a relative humidity of 95%, however cut stems may show some browning after this length of storage.

Rapid pre-cooling is not needed for cabbage but storage at 0° to 2°C is recommended if the product is to be kept for any length of time. Since the leaves are waxy and not susceptible to wilting, a high humidity cool room is not necessary.

Cauliflower is less perishable than broccoli but more sensitive to poor handling than cabbage. Cauliflower should be cooled by high humidity forced-air cooling as soon as possible after harvest. Storage should be at 0° to 2°C.

What is modified atmosphere packaging?

This type of packaging is more common for leafy brassicas such as pak choy but is also used for broccoli by some growers. Produce is cooled to between 1° and 5°C using hydrocooling methods and then stored in a plastic film or bag which lines the box to be used for transport. Currently, growers most commonly use 'Longlife' bags (available from Gelpack Australia and many other plastic companies).

Modified atmosphere packaging is permeable to carbon dioxide (CO₂) and oxygen (O₂) in a manner that allows the atmosphere inside the package to be maintained at a certain CO₂/O₂ ratio. This lowers the respiration rate of the product and slows deterioration. Modified atmosphere packaging can increase the storage life of some leafy brassicas by more than 100% when used in combination with low storage temperatures.

Quality assurance

Why do I need 'quality assurance'?

Because your customers are, or soon will be, asking for it. The driving force behind this push for quality is food safety and the fear of litigation. There have been enough instances of food poisoning or injury resulting from food consumption, for retailers and other businesses in the food industry to ignore them at their peril. Some of these occurrences have been due to contaminated fruit or vegetables.

New national Food Safety Standards became enforceable from February 2001. Fruit and vegetable growers are part of the food industry and so retailers, wholesalers, processors and other handlers of fruit and vegetables have placed requirements on suppliers to ensure that the products they sell are going to be safe to eat. In future, you will probably not be able to market fruit and vegetables without demonstrating that you have an effective food safety management system of some type in place. Quality management systems provide the framework for this to be achieved.

What quality assurance standard do I need?

If you market directly to a supermarket they will tell you what you need. It will be one of either SQF 2000^{CM}, SQF 1000^{CM}, ISO 9002 + HACCP or a supermarket Quality Management Standard.

If you supply to a wholesaler/agent or processor, you will need to be an approved supplier to them if they want to on-sell your product to the supermarkets. The minimum requirement to be an approved supplier to a wholesaler currently varies between wholesalers, but the Freshcare Code of Practice is gaining popularity around Australia as providing acceptable food safety practices to meet the supermarkets' requirements for approved suppliers.

What is HACCP?

The Hazard Analysis and Critical Control Point (HACCP) method is an internationally recognised, systematic approach to identify, evaluate and control hazards to product specifications. HACCP relies on prevention to ensure food is safe to eat, but has also been applied to ensure customers' quality requirements are met.



Quality management
Chapter 4 page 104

HACCP was developed from the need to produce safe food for the US space program and is now widely used by all sectors of the food industry as the preferred system to manage food safety. HACCP is a key component of SQF 2000^{CM}, SQF 1000^{CM} and the Woolworths Quality Management Standard. These standards require that HACCP address food safety and product quality.

What is an approved supplier program?

An approved supplier program involves suppliers carrying out practices that will provide assurance to a customer that produce is safe to eat and of acceptable quality. Suppliers need to keep sufficient records to demonstrate that the agreed practices are a part of everyday operations. The customer or someone on behalf of the customer will periodically check that suppliers are carrying out the practices.

Examples of where approved supplier programs are required:

- Growers supplying harvested produce to commercial packers and processors.
- Growers and packers supplying packed produce to wholesalers.
- Growers supplying packed produce to a marketing group.

What is Freshcare?

Freshcare is the name for a national, industry-managed program for certification of approved suppliers. It has been designed to provide independent auditing of a HACCP-based food safety program implemented by growers.

A Freshcare Code of Practice has been developed which lists practices and documentation growers need to implement in order to meet the requirements of a Freshcare audit, and so provide assurance to customers that their produce is safe to eat.

Environmental management

What is an EMS?

An Environmental Management System (EMS) is a systematic approach to managing the impacts that a business has on the environment. An EMS does not dictate levels of environmental performance, however it should enable a business to comply with legislative requirements concerning the environment. It should also build on existing activities such as industry best management practices, industry codes of practice and quality assurance schemes.

What type of EMS do I need?

We do not know when or what type of EMS will be required in the horticulture industry within the next few years. It will depend in part on the markets you are aiming to supply. As a minimum, you should become familiar with the Queensland Fruit and Vegetable Growers (QFVG) Farmcare Code of Practice for fruit and vegetables. It was developed by QFVG (now Growcom) to assist growers meet their general environmental duty of care under the Environmental Protection Act 1994.

The most widely recognised auditable international EMS standard is ISO 14001. This process standard requires a business to have an implemented, documented environmental policy in place which is available to the public. It also requires the business to have a documented environmental management system in place that is capable of being audited by an accredited third party. ISO 14001 does not prescribe specific levels of environmental performance but it does require a business to be able to identify and have access to all relevant environmental legislation.

In Europe, a protocol based on good agricultural practice called EurepGAP has been operating since the late 1990's. A significant number of Australian horticultural businesses are working towards EurepGAP in order to meet compliance deadlines stipulated by UK/European retailers and importers for 2004.

Enviroveg is a relatively new program from the Australian Vegetable and Potato Growers Federation (AUSVEG). Enviroveg is committed to encouraging vegetable growers throughout Australia to adopt and implement good environmental practices. It includes a self-assessment tool to help growers compare their current farming practices with the environmental best practice activities listed in the Enviroveg guidelines.



Environmental
management
Chapter 4 page 111

Farm safety

What are my workplace health and safety obligations?

Australian Agriculture has one of the highest rates of workplace accidents. Your obligation as an employer and farm manager are based on three principles—a concern for people and their well-being including yourself and your family; sound business management and compliance with current workplace health and safety legislation.

The best way to meet your obligations is to take part in the *Managing Farm Safety* program developed by Farmsafe Australia. This program is aimed at developing skills in risk management of farm safety—an approach that is consistent with the way other farm business risks are managed. The training course and resource package are based on real



Farm safety
Chapter 4 page 115

data about the major risks on Australian farms, including specific agricultural industries, and takes into account the requirements of current occupational health and safety legislation.

Marketing and economics

Are brassica crops worth growing?

In general terms, vegetables are in oversupply on the domestic market for much of the year. Prices can fluctuate widely and brassicas are no exception. There are seasonal trends for brassicas, with best prices usually received over the summer months. However, unless you are planning to grow the crop in the cooler, highland districts of Queensland, you will find it difficult to take advantage of these potentially higher prices. High summer temperatures make production of quality brassicas difficult in other parts of Queensland.

a key issue



Economics of production
Chapter 4 page 181

Brassica production is labour intensive, pest and disease management can be difficult; access to suitable cooling facilities is desirable for cabbage and cauliflower and essential for broccoli. Good management and communication skills are needed to produce and market the crop successfully.

Of the three crops, cabbage is perhaps easier to grow successfully for first-time vegetable growers. A cabbage crop has lower up-front input costs than cauliflower or broccoli. Cauliflower is the riskiest as production costs are high, yields can vary substantially and the crop requires more agronomic and management expertise to grow successfully. Investigate your target market thoroughly and make a realistic estimate of growing, harvesting and marketing costs before deciding to plant.

more info



AQIS offices
Chapter 5 page 284

Are there any requirements for exporting brassicas?

Produce destined for export markets must be of high quality and free from insect pests and disease. Requirements and product specifications vary for different markets. Some countries require a phytosanitary certificate, others do not. Product destined for export must, at some stage, pass through a Registered Export Establishment (REE). The Australian Quarantine and Inspection Service (AQIS) supervises registration of these establishments.

Growers intending to grow for the export market must undertake extensive market research to ensure that their product meets the specific requirements of the country and markets they intend to supply. A good relationship with wholesalers is essential to ensure that product meets both the customer's specifications and any quarantine requirements.



Before you **START**

If you have never grown cabbage, cauliflower or broccoli before, then you will find this section very useful. It is a brief checklist of the essential things you need to know before you start. It will help you make the right decisions. The information here is brief and to the point. We provide more detail on important areas in other sections of the book. Symbols on the left of the page will help you make these links.

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A brief overview of the Queensland brassica industry

Official statistics suggest that the Queensland brassica industry is relatively static, although supply tends to fluctuate from year to year. In 2001–02, around 40 000 tonnes of cabbage, cauliflower and broccoli were produced from about 2 800 hectares. Table 1 shows the industry had a farm gate value of about \$21 million and a gross value of around \$32 million.

Table 1. The Queensland brassica industry

Crop	Area (ha)	Production (tonnes)	Farm gate value (\$ millions)	Gross value (\$ millions)
Cabbages	366	13,148	2.7	4.7
Cauliflower	693	15,058	4.1	8.2
Broccoli	1758	11,569	14.3	18.8
Totals	2817	39,775	21.1	31.7

Source: *Australian Bureau of Statistics* 2001–02 estimates

Most Queensland brassicas are grown in the south-eastern corner of the State in the Lockyer Valley, Eastern Darling Downs and the Granite Belt. Small growing areas exist in coastal areas and other horticultural production districts of the state.

The industry primarily supplies the domestic fresh market, either through the central market system or direct to supermarket chains which account for the majority of sales. There are small markets for semi-prepared or semi-processed product (coleslaw, salad and vegetable mixes).

Brassicas from Queensland are sold throughout Australia. Fresh cabbage, cauliflower or broccoli can be sourced from Queensland at any time of the year but the main supply period is from May to September when the Lockyer Valley and Eastern Darling Downs are in full production. During the warmer months, production is centred in the cooler highland areas of the Granite Belt and around Toowoomba.

Returns can vary greatly. Prices are often low during peak production in winter. Summer prices are often high. In regions with warm or hot summers such as the Lockyer Valley, low yields, reduced head quality and pest and disease problems are often not offset by these higher summer prices.

Some larger brassica growers have actively pursued export markets for a number of years with some success. The major overseas markets for Queensland brassicas are south-east Asia and Japan, with \$5.7 million of broccoli, \$1.8 million of cauliflower and smaller quantities of cabbage exported during 2002–03 (Source: *Australian Bureau of Statistics*).

Know what you are getting into

The average price for broccoli, cauliflower and cabbage varies between seasons, making profitability and cash flow inconsistent and hard to estimate. The market is often oversupplied, particularly during winter and early spring, when returns may be below costs of production.

Consistent yields and quality can be difficult to achieve due to insect pests (for example, diamondback moth), disease problems (for example, head rots) and climatic factors. These include frosts, heat wave conditions or wet weather during harvest. Varieties also perform differently in various growing areas and under different growing conditions.

Growing brassicas is labour intensive, particularly at planting and harvest times, and there can be problems getting a good, reliable labour force.

Successful production requires cool to mild growing conditions, a well-drained soil and reliable irrigation. Capital costs can be high depending on arrangements for harvesting and packing of product. Access to rapid pre-cooling and cold storage facilities is essential for broccoli and highly desirable for cauliflower. Cabbage can be cooled and stored in a conventional cold room.

IMPORTANT
Do a marketing and business plan. This will give you a more accurate picture of what you are getting into.

Table 2 lists the some of the strengths, weaknesses, opportunities and threats (SWOT) affecting the brassica industry.

Table 2. Factors affecting the brassica industry of Queensland

Strengths	Weaknesses	Opportunities	Threats
Staple, well known products	Not suited to warm weather production	Value adding and semi-processing	Overproduction
High nutritional value	Cabbage and cauliflower not fashionable	Health aspects of the product	Lack of irrigation water (drought)
Versatile product	Generic promotions	Targeted promotion	Substantial price fluctuations
Value for money	Competition from southern states in domestic markets	New varieties	Club root
Convenient	Strong competition in export markets	Niche markets, organics, eco-labelling	Insecticide resistance problems
Reliable crop to grow in season with good management	Highly perishable product (broccoli, cauliflower)	New export markets	Labour, packaging and freight costs

What can you expect to make?

Yields vary considerably, depending on climatic conditions, pests and diseases, variety, season and planting density. Prices vary greatly, depending on supply and quality.

Cabbages are usually supplied in bulk bins and sold on a per head basis. Sugarloaf cabbages are often sold in waxed fibreboard cartons. Cauliflowers are sold either on a per head basis or, more commonly, in 78L cartons that hold 10 or 12 heads. Broccoli is usually sold in icepacks holding 8 kg of heads or in waxed fibreboard cartons holding 10 kg of product.

Production and marketing costs for cabbages, cauliflower and broccoli vary, depending on yields achieved, the size and efficiency of the operation and the cost structure of the business. Each farm is different. The estimates given in the following sections are intended only to illustrate the level of costs involved for growing, harvesting and marketing the different brassica crops.

Of the three crops, cauliflower is by far the riskiest crop to grow as production costs are high and yields can vary substantially. Cauliflowers also require a fair amount of agronomic and management expertise to grow successfully. Cabbage and broccoli are easier to grow. However, since broccoli is the more perishable of the three products, timeliness of harvest and access to adequate cooling facilities complicate crop management.

IMPORTANT

Estimate costs for your situation. See *Economics of production* in Chapter 4, Key issues.

Cabbage yields and prices

Marketable yields commonly range from 14 000 to 18 000 heads per hectare.

Price can range from \$0.20 to \$4.00 or more per cabbage head, but is usually in the \$0.60 to \$2.00 range. Figures 1 to 3 show average prices for ballhead cabbages on the Brisbane and Sydney markets and throughput of all cabbages at the Brisbane market for 2001 to 2003. The bigger the variation above or below the average price, the greater the opportunity or risk involved.



Market prices
Chapter 6 page 282

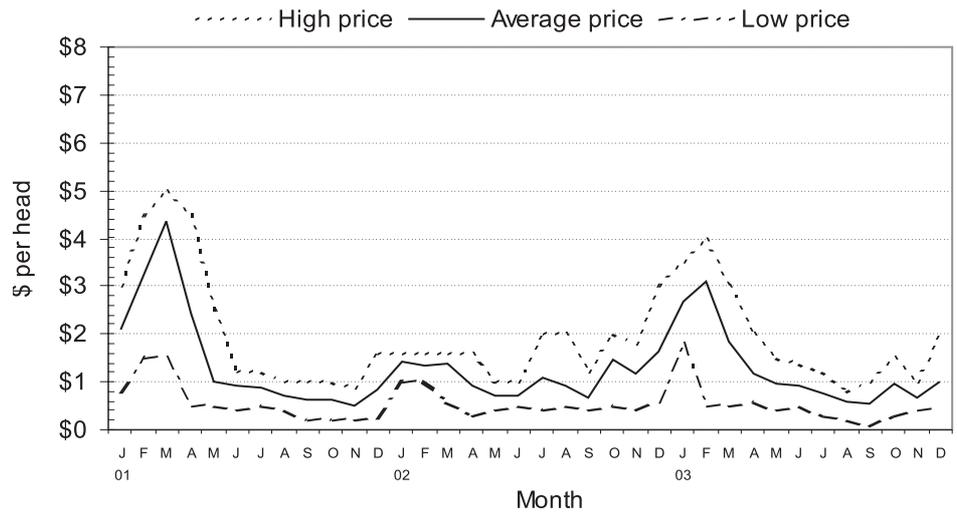


Figure 1. Average monthly price for ballhead cabbage on the Brisbane market 2001 to 2003

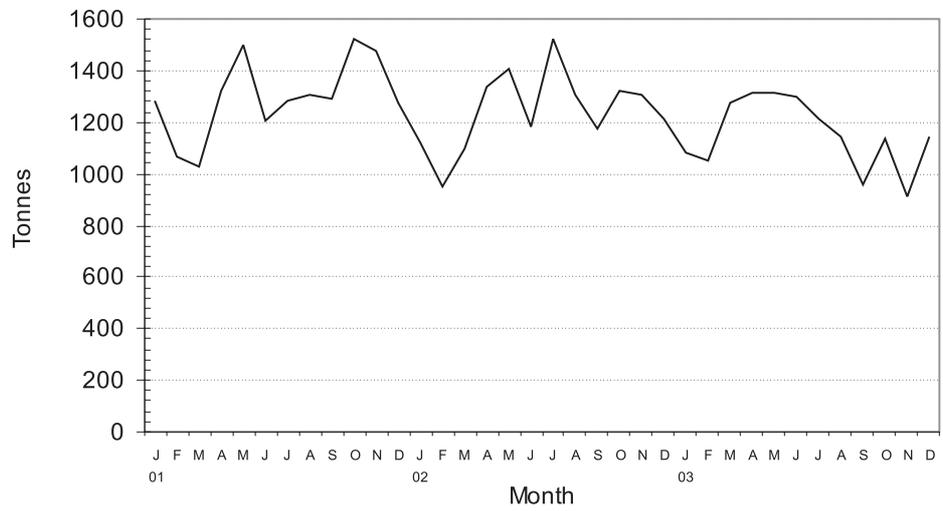


Figure 2. Throughput of cabbage on the Brisbane market 2001 to 2003

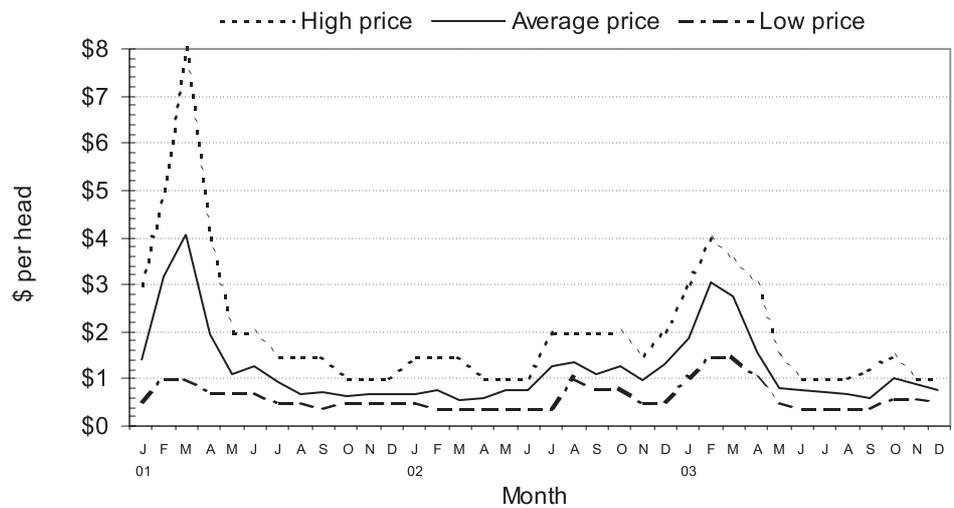


Figure 3. Average monthly price for ballhead cabbage on the Sydney market 2001 to 2003

Production costs for cabbage

Production and marketing costs in southern Queensland are at least \$0.70 per head. Variable growing, harvesting and marketing costs range from \$10 000 to \$16 000 or more per hectare.

Table 3 shows the estimated average costs of a southern Queensland crop yielding 16 000 heads per hectare sold in fibreboard bulk bins at \$1.00 per head on the Brisbane market.

Table 3. Example costs of producing and marketing a cabbage crop grown in southern Queensland

Costs	\$ per head	\$ per hectare
Growing	0.22	3 520
Harvesting (pick, pack & bin)	0.37	5 920
Marketing (freight and commission)	0.25	4 000
Total variable costs	0.84	13 440

Gross margin

At an average yield of 16 000 heads per hectare and an average price of \$1.00 per head, the gross return would be \$16 000/ha. The gross margin (income after deducting growing, harvesting and marketing costs) for the yield, price and cost averages used here would be \$2560/ha. To determine your net income, deduct fixed and capital costs such as rates, vehicle registration, insurance, electricity, administration, interest and living expenses.



a key issue

Cabbage gross margin
Chapter 4 page 87

Cauliflower yields and prices

Marketable yields commonly range from 1 500 to 2 000 cartons per hectare. Yields can be substantially lower during unfavourable growing conditions.

Price can range from \$2.00 to \$50.00 per carton, but is usually in the \$8.00 to \$18.00 range. Figures 4 to 6 show average prices and throughput at the Brisbane market and prices at the Sydney market for 2001 to 2003. The bigger the variation above or below the average price, the greater the opportunity or risk involved.



more info

Market prices
Chapter 6 page 282

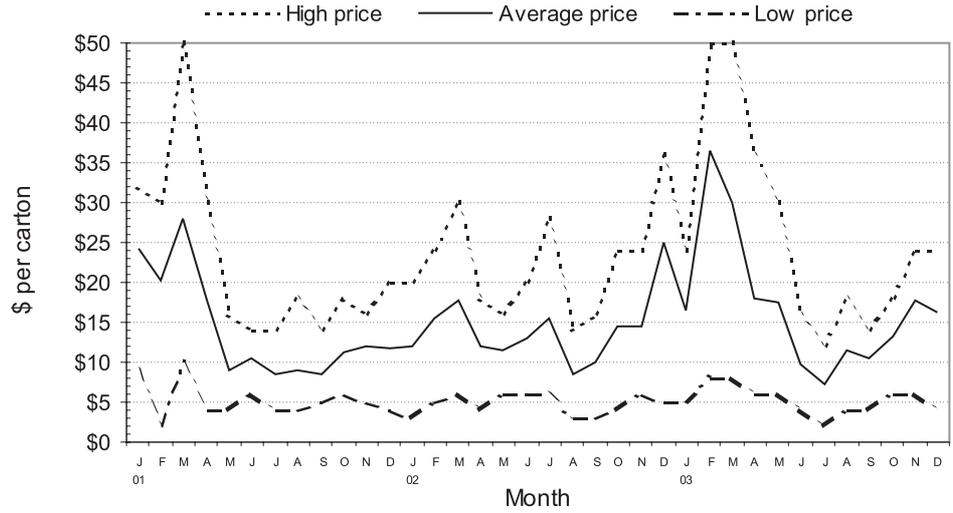


Figure 4. Average monthly price for cauliflower on the Brisbane market 2001 to 2003

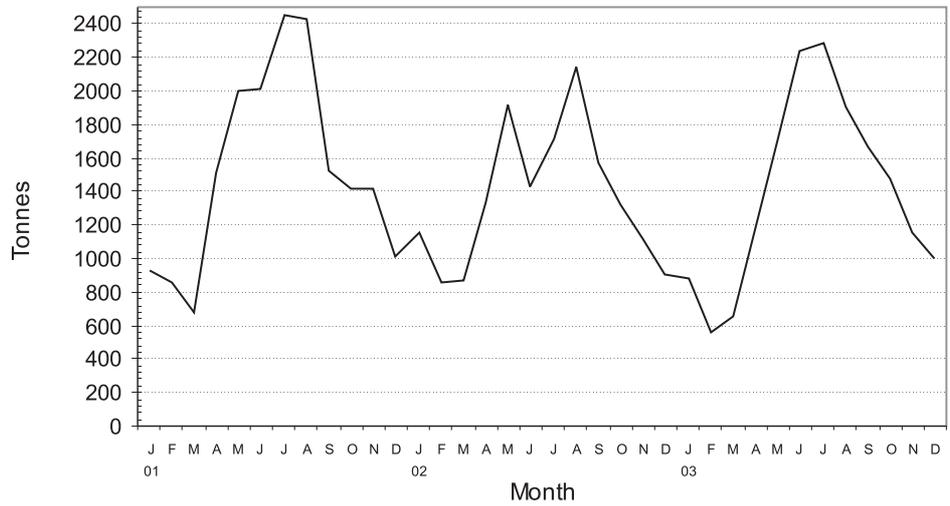


Figure 5. Throughput of cauliflower on the Brisbane market 2001 to 2003

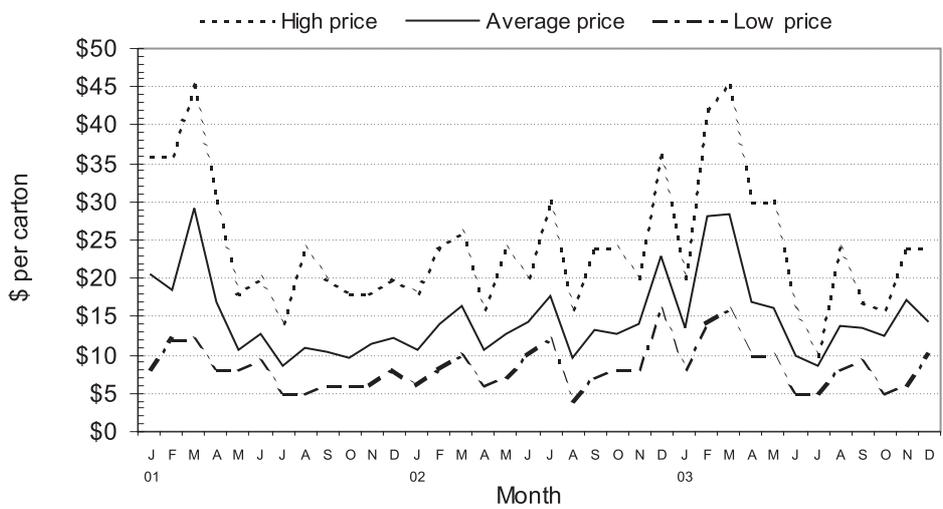


Figure 6. Average monthly price for cauliflower on the Sydney market 2001 to 2003

Production costs

Production and marketing costs in southern Queensland are at least \$9.50 per carton. Variable growing, harvesting and marketing costs are at least \$14 000/ha, but can be \$20 000 or more per hectare. The evenness of crop maturity will have a significant impact on harvesting costs.

Table 4 shows the estimated average costs of a southern Queensland crop yielding 1 700 cartons per hectare sold at \$12 per carton on the Brisbane market.

Table 4. Example costs of producing and marketing a cauliflower crop grown in southern Queensland

Costs	\$ per carton	\$ per hectare
Growing	2.77	4 709
Harvesting (pick, pack & carton)	5.61	9 537
Marketing (freight and commission)	2.35	3 995
Total	10.73	18 241

Gross margin

At an average yield of 1 700 cartons per hectare and an average price of \$12 per carton, the gross return would be \$20 400/ha. The gross margin (income after deducting growing, harvesting and marketing costs) for the yield, price and cost averages used here would be \$2159/ha. To determine your net income, deduct fixed and capital costs such as rates, vehicle registration, insurance, electricity, administration, interest and living expenses.



a key issue

Cauliflower gross margin
Chapter 4 page 90

Broccoli yields and prices

Marketable yields commonly range from 700 to 1000 icepacks per hectare.

Price can range from \$3.00 to \$40.00 per icepack, but is usually in the \$12.00 to \$22.00 range. Figures 7 to 9 show average prices and throughput at the Brisbane market and prices at the Sydney market for 2001 to 2003. The bigger the variation above or below the average price, the greater the opportunity or risk involved.



more info

Market prices
Chapter 6 page 282

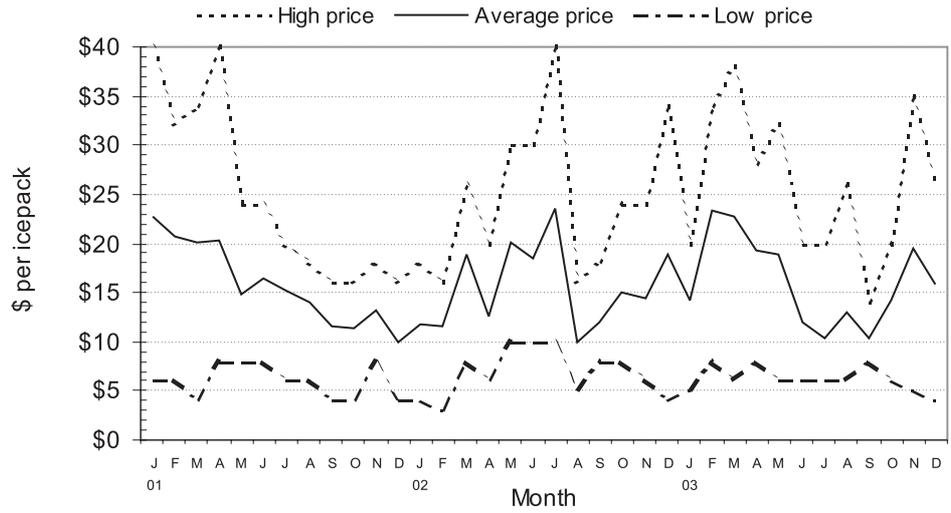


Figure 7. Average monthly price for broccoli on the Brisbane market 2001 to 2003

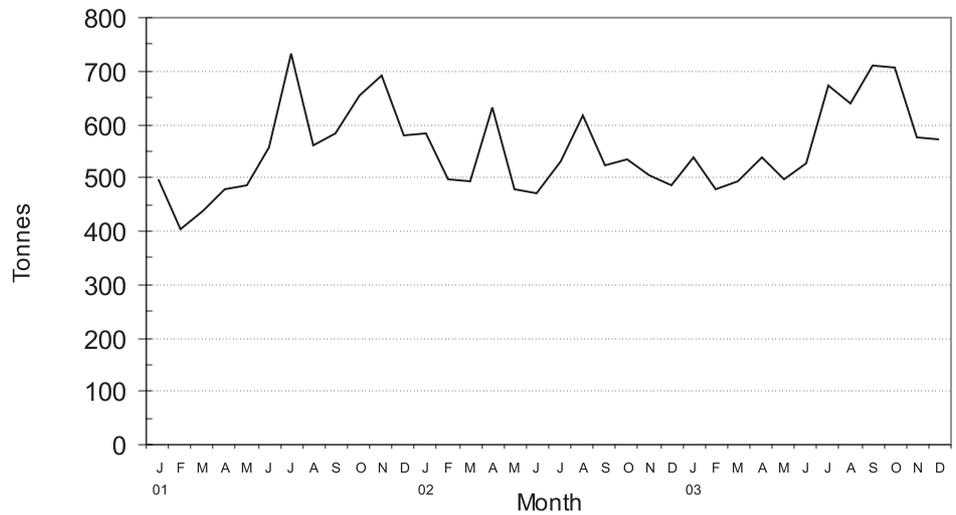


Figure 8. Throughput of broccoli on the Brisbane market 2001 to 2003

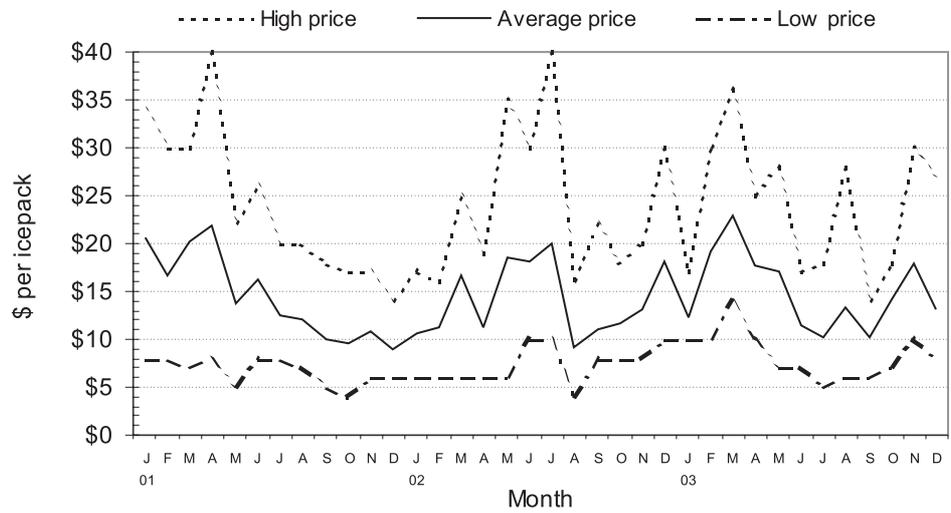


Figure 9. Average monthly price for broccoli on the Sydney market 2001 to 2003

Production costs

Production and marketing costs in southern Queensland are at least \$13.00 per icepack. Variable growing, harvesting and marketing costs range from \$11 000 to \$15 000 or more per hectare.

Table 5 shows the estimated average costs of a southern Queensland crop yielding 900 icepacks per hectare sold at \$16.00 per icepack on the Brisbane market.

Table 5. Example costs of producing and marketing a broccoli crop grown in southern Queensland

Costs	\$ per icepack	\$ per hectare
Growing	4.75	4 275
Harvesting (pick, pack & icepack)	6.66	5 994
Marketing (freight and commission)	2.50	2 250
Total	13.91	12 519

Gross margin

At an average yield of 900 icepacks per hectare and an average price of \$16 per icepack, the gross return would be \$14 400/ha. The gross margin (income after deducting growing, harvesting and marketing costs) for the yield, price and cost averages used here would be \$1881/ha. To determine your net income, deduct fixed and capital costs such as rates, vehicle registration, insurance, electricity, administration, interest and living expenses.



Broccoli gross margin
Chapter 4 page 93

Capital required

Assuming that you own or have access to suitable land, it would cost around \$250 000 to \$300 000 to buy the minimum amount of new machinery, plant and equipment needed to set up a 20 to 30 hectare brassica enterprise. This will depend on which crop you grow and what harvesting and packing arrangements you use. Cabbage would generally be less capital intensive than broccoli or cauliflower.

To reduce capital outlays, you could lease or borrow equipment and contract harvesting and packing operations. Second-hand equipment prices are normally about half that of new equipment, depending on condition and age.

You will also need to finance production and marketing of the crop. Brassicas are usually planted on a weekly schedule over a number of months. You may be looking at investing \$100 000 to \$200 000 in variable growing, harvesting and marketing costs before receiving a gross return from the first harvest.



Getting the crop started
Chapter 3 page 34

The farm you need

Soil

Brassicas will grow on most soil types but the crop needs at least 300mm of friable, well-drained topsoil. Poorly drained soils or heavy clay soils become waterlogged after rain or irrigation, making crop management more difficult. Brassicas prefer a slightly acid soil (pH 6.0 to 6.5) but will tolerate a slightly alkaline soil, up to pH 7.5.

Climate

Brassicas grow best under cooler temperatures. Mild, sunny days with temperatures between 15° and 25°C and cool nights with temperatures between 10° and 15°C are considered ideal. Heavy winter frost (below –4°C) can damage heads and will kill young seedlings. Some varieties will tolerate hot conditions but high temperatures will reduce both head quality and yields. Cauliflower is particularly sensitive to temperature extremes.

During extended rainy weather, plants are more likely to become infected with diseases such as black rot and bacterial head rots. These are difficult to manage once the disease is established in the field. Rainfall will also restrict machinery operations, particularly on heavy soils.

Brassica crops are attacked by a range of butterfly and moth larvae (caterpillars). These can be difficult to control, particularly in the warmer months.

Slope

Ideally slopes should be no more than 3%. A slight slope will provide better drainage while still allowing for efficient irrigation and use of machinery. Steep slopes will be more difficult and expensive to work. Uniform slopes are desirable but not essential. Soil erosion can be a problem on steep slopes while depressions can result in waterlogging.

Slopes above 5% require recognised soil conservation practices. Slopes above 8% make machinery operations hazardous and it can be difficult to maintain uniform irrigation.

Water

An adequate water supply is essential to ensure economic yields of high quality product. Each crop will require 2.5 to 4 megalitres (ML) of water per hectare, depending on season, soil type and crop type. This is equivalent to 250 to 400 mm of total rain and/or irrigation over one hectare of land.



Prepare the land
Chapter 3 page 41

When surface water, for example dams, is your main source of irrigation water, a storage capacity of 6 to 8 ML will be required for each hectare of crop grown. This will ensure that you have adequate water supplies to meet peak irrigation demands even in unseasonably dry conditions.

Brassicas are usually watered with overhead irrigation systems although some growers are switching to drip (trickle) irrigation.

The crop is moderately sensitive to poor quality water. Electrical conductivity is a measure of water salinity. Table 6 shows the water conductivity threshold for different soil types at which yield reductions may occur.



Irrigation management
Chapter 4 page 168

Table 6. Water conductivity threshold for different soil types

	Sandy	Loam	Clay
Cabbage	3.5 dS/m	2.0 dS/m	1.2 dS/m
Cauliflower	3.2 dS/m	1.8 dS/m	1.1 dS/m
Broccoli	4.9 dS/m	2.8 dS/m	1.6 dS/m

Source: *NRM Facts, water series W55*

Until recently water conductivity was reported in microSiemens per centimetre ($\mu\text{S}/\text{cm}$), however it is now reported as deciSiemens per metre (dS/m).

To convert from $\mu\text{S}/\text{cm}$ to dS/m use the following formula.
microSiemens per centimetre ($\mu\text{S}/\text{cm}$) divided by 1000 =
deciSiemens per metre (dS/m)

Example: 1200 $\mu\text{S}/\text{cm}$ divided by 1000 = 1.2 dS/m

To convert from deciSiemens per metre to microSiemens per centimetre multiply by 1000.

Example: 1.2 dS/m x 1000 = 1200 $\mu\text{S}/\text{cm}$

The machinery and equipment you need

The machinery and equipment required will depend on the size of the enterprise and crop grown. Table 7 lists the machinery and equipment considered essential for brassica production on a small scale (20 to 30 hectare). Machinery, plant and equipment listed as desirable would make management easier by increasing flexibility and would be considered essential in a larger enterprise.

The prices listed in the table are estimates only. Rather than buying new machinery you could lease, borrow or buy second-hand equipment to reduce capital outlays. Harvesting, cooling and packing can be contracted out in most major vegetable production districts.

Table 7. Estimated cost of new machinery and equipment

Equipment	New price \$
ESSENTIAL	
Tractor (26 kW) for planting, cultivation, spraying, harvest	30 000
Tractor (45 to 60 kW) for discs, ripper, rotary hoe	60 000
Truck or tractor and trailer	10 000–40 000
Cultivation equipment	20 000–25 000
Bed-former	2 000
Transplanter	4 000
Fertiliser spreader	10 000
Spray equipment for crop	10 000
Irrigation equipment	80 000
Tractor mounted forklift	10 000
Pallet jack	700
DESIRABLE	
Power harrows (1.5m width with bed-former)	17 000
Spray equipment for herbicides	4 000
Harvest aid	26 000
Shed forklift	30 000
Slasher/pulveriser	3 000–6 000
Sorting/packing tables and equipment	10 000
20 pallet coldroom	35 000
Forced air cooling facilities (8 pallet room)	50 000

The labour you need

One person could grow 10 to 15 hectares of crop over a six-month period with additional labour to help with transplanting, harvesting and packing. Cabbage production is less labour-intensive than cauliflower and broccoli growing.

Three people plus a driver are required for planting. This team could plant out around 5000 to 7000 transplants per hour.

A team of four can cut around three half-tonne bins of cabbage per hour. Six to eight people are needed to operate a harvest aid efficiently. Using a harvest aid, a team of eight could pick and pack between 40 to 50 icepacks of broccoli per hour or 60 to 80 cartons of cauliflower per hour. Cutting and packing rates would slow considerably when more than two or three passes are needed to harvest the crop.

Transplanting, harvesting, cooling and packing operations can be contracted out for all three crops; this reduces problems associated with managing a large number of staff.

Other considerations

Growing brassica crops involves hard, physical work. This includes land preparation, planting, spraying for weed, pest and disease control, fertilising, irrigating, harvesting and packing. There is a high labour requirement for transplanting, picking and packing, particularly for product sold in cartons or icepacks.

Management skills or access to consultants with these skills are required for managing finances, administration, staff and the crop. Good communication skills, or staff with these skills, are essential for successfully managing labour and organising markets. Skills in machinery operation and maintenance, the ability to read and understand chemical labels, and skill in observing and fixing problems in their early stages, are essential. Careful attention to detail is necessary to be a successful brassica grower.

Quality of the end product is most important in successful cabbage, cauliflower or broccoli growing. This starts with good land preparation, careful selection of varieties to suit the district and season and continues through the growing of the crop, harvesting, cooling, packing and marketing.

Brassica crops may be grown organically. However, it can be difficult to achieve adequate weed, pest and disease control.



Organic production
Chapter 4 page 260
