Evaluating Water Secure Sites

Thomas Robson
Harvest FreshCuts Pty Ltd

Project Number: VG06151

VG06151

This report is published by Horticulture Australia Ltd to pass on information concerning horticultural research and development undertaken for the vegetables industry.

The research contained in this report was funded by Horticulture Australia Ltd with the financial support of Harvest FreshCuts Pty Ltd.

ISBN 0 7341 2005 2

Published and distributed by:
Horticulture Australia Ltd
Level 7
179 Elizabeth Street
Sydney NSW 2000
Telephone: (02) 8295 2300
Fax: (02) 8295 2399

HAL

Know-how for Horticulture™

VG06151- Evaluating Water Secure Sites

Milestone No 190

Due Date 30/04/09

Achievement Criteria All necessary reports complying with Horticulture Australia's requirements received and approved by Horticulture Australia Ltd

Authors Tom Robson et al

Research Provider – Harvest Fresh Cuts Pty Ltd

This project was facilitated by HAL in partnership with the vegetable industry

VG06151- Evaluating Water Secure Sites

Project Leader

Tom Robson

Tel: 07 3712 3901

Mob: 0403 833 194

Fax: 07 3879 3255

Email: tom.robson@oneharvest.com.au

Postal Address: PO Box 180 Carole Park Qld 4300

Project Support

Rob Munton

Tel: 07 3712 3965

Fax: 07 3879 3255

Email:rob.munton@oneharvest.com.au

Report Purpose Statement

The purpose of this report is to collate and examine all the information gathered over the life of this project and provide industry with recommendations on locations, growing techniques and "know how" about the successful production of conventional and organic lettuce and baby leaf in sustainable growing regions.

Acknowledgments

Britton Produce

29 April 2009

Table of Contents

Media Summary

The key components of the project

- Overseas study tour to identify best practice in semi-arid growing regions in California & Arizona
- Site Evaluation in Australia - desk top study followed by in-field assessment to identify potential new production regions in Australia
- Best Practice Evaluation - Processing trials to determine the suitability of the trial product for fresh-cut processing
- Technology transfer - Final Report & webpage publication

What is the industry significance of the project?

- Global climate change & drought is threatening water quality and quantity in traditional leafy salads growing regions leading to supply shortages, food contamination or industry unemployment.
- There is a significant opportunity in the marketplace for organic leafy salads.
- This project addressed the development of new climatic regions, and the fast-track development of organic production.

Key outcomes & conclusions

- Multiple areas were identified and assessed for growing suitability and harvested products were assessed for processing capability and consumer acceptance.
- A key learning was that “green field” site does not necessarily fast track organic certification due to past agricultural and/or horticultural activities
- Of the many potential production regions outside of the traditional growing areas, there is no one area that is a “silver bullet”, all have advantages and disadvantages

Recommendations for future R&D

- Develop a method for the evaluation of future “green-field’ sites with consideration to prior long term use
- Develop the crop varietal selection criteria for new regions
- Develop training programs with regional educational institutions in new regions

Recommendations for practical application to industry

- Adherence to Salad-GAP guidelines is essential for food safety
- Plant variety selection is critical - what works in one region may not work in another
- Assess the total supply chain costs before investing capital - new regions may not have the necessary infrastructure
- Consider the labour availability in new regions
- Full report can be downloaded at http://www.oneharvest.com.au/content/?id=217

Technical Summary

The nature of the problem

- The traditional leafy salads growing regions are located in regions faced with increasing pressure on both quantity and quality of irrigation water supplies. The potential implication is that supplies for processing businesses and the wholesale market will be severely restricted in the near future
- Stored water supplies face an increased risk of faecal contamination from native fauna, stock grazing and human activity. The widely reported North America food contamination incident of 2006, involving the contamination of fresh-cut spinach with E.coli 157:H7 infected 205 people, of whom 103 were hospitalised and 3 died[1]. The US FDA reported on March 3rd 2007 that the potential environmental risk factors for E.coli O157:H7 contamination at or near the field included the presence of wild pigs, the proximity of irrigation wells used to grow produce for ready-to-eat packaging, and surface waterways exposed to faeces from cattle and wildlife.

  [1] *http://oversight.house.gov/documents/20080312103036.pdf*

- A food safety issue arising from a similar type of issue in Australia would cause widespread unemployment and very major financial implications for growers, distribution companies, wholesalers and processors throughout the entire lettuce and salads industry. This risk has been separately addressed in HAL assisted project OT06011 (Salad Producers Forum-Good Agricultural Practise Project), and the learnings from the project OT06011 must be applied in conjunction with this document.
- The conversion of conventional land typically takes three years to attain full organic certification. In contrast, the certification of virgin land takes a few months to achieve certification. This project addressed possibility of fast-tracking organic land development.

Brief description of the science undertaken

Desktop study & study tour

- Analysis of weather data and identification of potential growing regions
- Visit to Yuma, Arizona meeting and interviewing lettuce producers in semi arid regions. Key insights into growing, harvesting and organics were obtained during this trip and the results section of the full report outlines the outcomes and learning.
- Employment of project advisor with 7 years experience in growing conventional and organic lettuce in Portugal and Spain

Site Evaluation

The project identified multiple potential regions for lettuce production and are detailed in this report. The initial strategy of the project was to evaluate and trail land in Ti Tree, Northern Territory. During the site evaluation stage of this project it was decided that Ti Tree was not the most suitable region for conducting the trials. This was due to soil analysis and environmental factors. The long distance to market and the costs associated with that also played a role in making this decision. The main factor for the variation however was that simply after this stage of the project, better sites were identified, particularly sites that could offer year round (or close to) production.

Best practice evaluation

Please refer to the results of the HAL assisted lettuce project (VG03092) and baby leaf project (VG05068). These were used as a guide to likely best practice growing and supply chain. As expected, the practices would need to be adapted to suit the particular region and block and would continue to be developed for the life of the project. Appendix 1 details the latest Horticultural Management Plan for the chosen sites. As can be expected on new growing sites, the adapted Horticultural Management Plans produced mixed results. Overall, spinach performed very well but iceberg and cos had varied results and need further investigation.

Technology transfer

The data and recommendations found during this project can be applied by any interested party. They can be found throughout this report and on the dedicated webpage and include:

- Region identification and suitability
- Horticultural Management Plan
- Soil analysis
- Quality assessments

To date, 3 of the industries largest lettuce growers have visited the chosen site on at least 2 occasions each. 1 of these growers took part in the growing and data capture for the organic trials on their own property. As part of the project, AHR completed 2 reports titled “New Lettuce and Babyleaf Locations” and “Potential Lettuce Growing Regions in Southern Australia”. The results are included in this report. 10 representatives from Vegco Pty Ltd (a OneHarvest company) attended a field day in October 2008 and although not having visited the site, national buyers for both Woolworths and Coles are very much aware that new regions are being trialled to ensure safe and secure lettuce supply and fully support the investment.

A webpage has been set up to provide access to all interested parties – http://www.oneharvest.com.au/content/?id=217

Major research findings and industry outcomes

- The regions outside of traditional growing areas that would be suitable for organic and conventional lettuce production include but are not limited to Warrnambool, Port Fairy, Portland, Cashmore, Cape Northumberland, Cranbourne, Mt Gambier, Hobart and Forth. The Results section of the full report and Appendix 6 illustrates optimum range weather data for these regions and others.
- Although different inputs are required, yield, days to emergence, head weight and days to harvest were very similar for both organic and conventionally grown lettuce. The same varieties were also chosen to grow both.
- With significant research and investment, safe and secure supply of lettuce to the fresh-cuts salad industry in “non-traditional’ growing areas could effectively “fill the gap” of supply when traditional regions are affected by drought or hail and therefore enhance domestic production and reduce the risk of imports.

Recommendations to industry, research peers and HAL

- Further trials initiated in identified regions
- Increase production quantities on chosen site
- Further soil analysis and pre planting input adjustments
- Training programs in conjunction with TAFE’s, universities and/or other training institutions for lettuce production in these areas could encourage more investment into these crops
- Further consumer market research on organics

Contribution to new technology and any future work suggested

- Soil and product testing regime to test “green field” site suitability, paying particular attention to fertiliser applications in prior years and the implications that come with cropping land after so much prior use
- Variety selection criteria for green field sites and subsequent trialing regime

Introduction

The aim of this project was to identify and trial totally new growing regions in regional Australia for a range of whole head and baby leaf lettuce crops. The project planned to grow conventional and organic lettuce in semi-arid regions utilising ground water supplies for irrigation.

Harvest FreshCuts Pty Ltd is one of the largest processor of fresh-cut salads in Australia, and at the time the project was undertaken, directly employed 464 people in the processing and marketing of these products in Queensland and rural Victoria. The traditional leafy salads growing regions of Australia in South East Queensland and East Gippsland are facing increasing pressure on both quantity and quality of irrigation water supplies. The potential implication, if this problem is not addressed, is that supplies for the processing business, and indeed for the wholesale market, will be severely restricted in the near future. Further, as stored surface water supplies come under increasing pressure, the risk of faecal contamination will increase, potentially increasing the risk of a major food contamination incident.

A sustained supply shortage or a significant food contamination incident would directly lead to a major loss of employment opportunities in the processing, farming and distribution industries.

Further, at the time the project was undertaken, there was a significant opportunity to develop a range of organic leafy salad products in the Australian market. The conversion of conventional land typically takes three years to attain full organic certification. In contrast, the certification of virgin land takes a few months to achieve certification.

The strategy for this project is to evaluate and trial land in Ti Tree Northern Territory, and conduct a series of growing trials over the 2007 winter growing season to evaluate the capability of the location to produce a reliable and safe supply of high quality conventional and organic lettuce crops. After the site evaluation stage of this project, the project team elected to not use the Ti Tree location but instead identified an alternate location that offered more potential from a growing and supply chain perspective. The location decided upon was Mount Gambier, South Australia. This decision however affected the organic portion of project as the chosen site would not be able to be converted inside the timeframe of the project. The project team believes there is still a market for organic lettuce so were determined to persist with this part of the project. As a result, organic production took place in the traditional growing area of Bairnsdale, Victoria on land already certified organic.

It was found that fast tracking the development of Greenfield sites to organically certified sites was very difficult. In fact, in most cases impossible. The majority of the regions identified have had some sort of agricultural and/or horticultural practices performed at a minimum, within the last 3 years but in most cases, for much more than 3 years.

HAL projects VG03092 and VG05068 outlined growing and supply chain best practice for lettuce and baby leaf. The results of these project were used as the base from which all agronomic decisions were made. The methods were adapted to suit the conditions of each of the regions.

Materials & Methods

Harvest FreshCuts Pty Ltd partnered with associate company Oolloo Farm Management Pty Ltd, specialist Baby Leaf lettuce grower, Britton Produce & Applied Horticultural Research (AHR) to develop a protocol for the production of leafy salads in a non traditional growing region.

There are regions in Australia which are not currently being used to grow leafy vegetables, but which show promise for lettuce and baby leaf production.

Because these regions are unproven they represent a substantial agronomic and post harvest risk.

In the absence of a detailed and quantified understanding of the performance of the region it is essential to test the new growing region over a number of plantings to be confident the results are correct.

The following activities required to achieve the objectives of the project were grouped into four areas. These are:

- Study tour to identify best arid area growing practices
- Site evaluation
- Best practice evaluation
- Technology transfer

Study tour to identify best arid area growing practices

Two project team members travelled to California and Arizona and visited multiple lettuce farms. The purpose of this visit was to gain an understanding of conventional and organic growing practices in a semi arid climate zone. The Results section of this report details the learnings from this trip and how they were applied to the project.

Site Evaluation

A desk top study was completed and indicated many areas as having potential for the production of lettuce and baby leaf crops in the summer, spring and autumn periods, and possibly through winter. Several water secure sites were assessed and evaluated using minimum and maximum temperatures, daylight hours and rainfall data sourced from the Bureau of Meteorology. These included:

- Warrnambool
- Port Fairy
- Portland
- Cashmore
- Heywood
- Terang
- Colac
- Gelibrand River
- Rennick
- Cape Northumberland
- Mount Gambier
- Murray Bridge
- Cranbourne
- Sale
- Bairnsdale
- Forth
- Hobart

The chart below headed Regions Evaluation uses the temperature limits referred to in the table immediately below to compare current and potential areas for lettuce growing in Australia.

	Germination (^oC)	Growth (^oC)	Mapping limits
Min	2.2	7	Min. = 7
Optimum range	18-21	12-21	
Max	27 **	24	Max. = 24

Notes:

1 - high temperature dormancy above 27^{o}C. is a limitation

2 - germination at 0^{o}C. = 49 days, and at 5^{o}C. = 15 days (see optimum range)

** = limiting factors

The following table outlines the outcomes of the desktop study and research trips.

Regions Evaluation	Comments on suitability of temperature for lettuce production
Western Victoria and South Australia - coastal	Winter rainfall pattern: applied to all Victorian sites and should be taken into account for winter production.
Warrnambool	Potential for all year round production.
Port Fairy	Even milder climate than Warrnambool. Potential for all year round production.
Portland	Potential for all year round production.
Cashmore	Potential for all year round production.
Heywood	OK for summer but too cold for winter. October → mid May.
Terang	Too cold in winter and too hot in Mid summer. Suited to production between mid October → end of December, then early March → mid May.
Colac	Similar pattern to Terang.
Gelibrand River	Not as well suited as other areas in the region. Too cold in winter and too hot in Mid summer. Production possible between: late October → end December and early March → late April. High rainfall in winter possible.
Rennick	Similar to Gelibrand River
Cape Northumberland	Potential for all year round production. Well suited to summer production.
Mt Gambier	Marginally too hot in summer and too cold in winter. Possible production slot start October → Mid May with the potential for some problems in summer due to hot weather.
Murray Bridge	Too hot for summer production.
Naracoorte	Mid September to end of October

	early April to end of May
	Too hot for summer production. Really a bit cold for winter, but would probably be OK –just a bit slow.
Southern Victoria	
Cranbourne	Good area for all year round production. Marginally too hot in summer. Not as good as some regions to the West of Melbourne. Current production area.
Gippsland Region	
Sale	Similar to Bairnsdale.
Bairnsdale	Really too hot in summer. Best production from mid September → mid December and then early march → mid May. Current summer production area. Risk of summer high temperature spikes.
Tasmania	
Forth (Forthside, near Devonport)	Good potential for summer production from mid October → end of April. Too cold in winter. High rainfall in winter.
Hobart	Potential for all year round production. Good summer temperature pattern. Marginally cold in winter which would slow growth. Less rain than Forth in winter.

The project team in conjunction with AHR compiled a report titled “Potential Growing Areas for Babyleaf Spinach Rocket and Lettuce in Australia” the results of this report are found in the Results section and Appendix 4 and 6 of this report.

After the initial list of areas was identified, a research trip to comparable locations was undertaken to choose a suitable site and eventually fine-tune the growing practices that have the highset chance of success. An Applied Horticultural Research (AHR) agronomist accompanied OneHarvest staff on this site evaluation visit. The sites visited were Mount Gambier, Warnanbool and Naracoorte. The reason for choosing these sites was they all had secure water supply.

Below is a table outlining the advantages and disadvantages of each site:

Advantages	**Disadvantages**
Warrnambool	
• 560km to processing facility • Great soil and water • Long harvest window	• Shortage of good soil types • High wind • High land cost • High lease cost $400+/acre • Skill set shortage? • Low infrastructure
Mount Gambier	
• Large amount of good soil type available	• 720km to processing facility

• Water availability • Ability to lease land • Lease cost $200/acre	• Forestry pushing land prices up • Warmer climate than Warrnambool • Level of infrastructure higher than Warrnambool but still low
Naracoorte	
• Larger land and water availability • Infrastructure of specific site identified • Ability to be 'home base' while leasing ground at other locations for Jan / Feb	• 720 km to processing facility • January/February may be too hot for Whole Head • Appropriate skills available

Considerable challenges were identified for each of these non traditional lettuce growing regions. The major challenges were:

- Appropriately skilled labour – as lettuce was not grown the identified areas, all labour had to be trained on new growing practices, implement use and product qualilty
- Supply chain – for the same reasons as labour, willing and able logistic companies were difficult to find.
- Suitable land for speedy organic conversion – all the of land identified had prior agricultural use. Therefore organic conversion was not going to be a quick as was first planned.
- The "green field" factor – as growing is such a dynamic process, the time it takes to gain an appropriate understanding of soil and weather should never be underestimated. New people, on new ground, with unknown weather conditions and a lack of skilled labour creates a drain on human and capital resources.

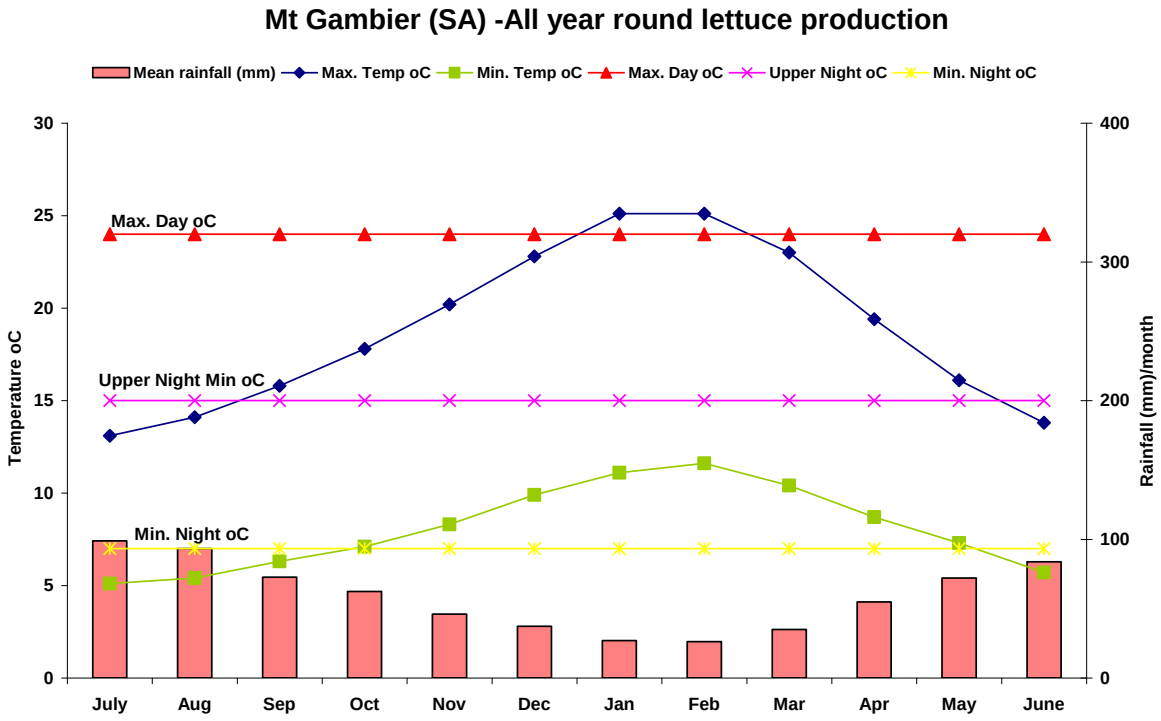
Of all the 3 sites visited, Mount Gambier, South Australia was identified as the area with the most secure water together with the key attributes needed for the successful production of leafy salad crops. As a result, 10 hectares of a 32 hectare site was developed for the production.

Due to the site having a history of agriculture, fast tracking organic conversion was not possible. Therefore, the organic trails were done on land already certified in Bairnsdale, Victoria. In hindsight, continuing with the organic trials on other sites was a benefit to the project. As mentioned previously, the "green field" factor challenge described above should not be underestimated. The project team believes that attempting to grow organic and conventional on the new site concurrently, in the timeframe set our in the initial project scope would have resulted in more issues for both crops and therefore unsatisfactory results and reporting for this project.

Following is meteorological data for Mount Gambier, sourced from the Australian Bureau of Metrology:

Mount Gambier

Latitude: 37.75 °S Longitude: 140.77 °E Elevation: 63 m



A preliminary report conducted by AHR stated:

From a temperature perspective, the site should be suitable for all year round production. The summer maximums are fine, and on the whole the winters are slightly cold on average. There may be high temperature spikes in summer which may cause quality problems and frosts in winter may also result in some crop losses.

There is some significant winter rainfall which may cause some foliar disease problems, but perhaps more importantly, cloudy weather combined with low temperature may result in a very long crop growth cycle in winter. This will need to be taken into account for scheduling purposes.

As a consequence of these recommendations and other factors mentioned above, a block was leased in August 2007 and the suitable plant and equipment (a list is provided in Appendix 7) was purchased to prepare, work, plant, harvest and maintain the block.

The spinach, and lettuce seeds were purchased and planted, and the chemicals required to produce the leafy salad crops were applied. Appendix 1 outline the Horticultural Management Plans or chemical and nutrition growing plans.

The block set up was as follows with 10m spacings between above grown sprinkler head on irrigation infrastructure laterals:

Bed width – 1400mm

Wheel tracks – 600mm

It should be noted that land previously used for agriculture has major implications for food safety from a microbiological point of view. The project team STRONGLY recommends SaladGAP certification for any new site development. This will ensure the necessary steps are taken to eliminate the risk of a food safety incident.

Best Practice Evaluation

Planting reported on this project commenced on all both sites every 2 weeks from 26 November 2008 to 20 March 2009. Varieties of the following crops were planted:

- Iceberg Lettuce
- Cos Lettuce
- Spinach
- Rocket
- Red Coral
- Green Coral
- Red Velvet
- Chard
- Mizuna
- Tatsoi

The scope of this project covered iceberg, Cos and Baby Spinach. The choice of varieties grown were based on the varieties used in the southern Australia and were:

Iceberg	• Sureshot • Kong • Marksman • Gaitlin • Lagunus • Silverado • Cartegenus • Seagull • Steamboat
Cos	• Avidius • Goblin • RZ4193Glory • Quintus • Cosmic
Spinach	• Pelican • Roadrunner • Nighthawk • Greyhound • Crocodile • PV0495F1 • Toucan

Soil Analysis

Referring to Appendix 2, the soil on the new site in Mount Gambier appeared to be a sandy loam with a reasonably high nutrient holding capacity (CEC=17 meq/100g (although units not shown on soil test report). The soil organic matter level is good and it is not saline or sodic. The pH is slightly acidic but within the normal range and will not limit nutrient uptake.

In more detail:

Nitrogen: Background nitrogen levels reported in the soil test are likely to be in the form of soil organic matter and probably not available for immediate plant uptake. (Nitrate or ammonium N levels not shown). I suggest applying full crop requirement.

Phosphorus levels are only moderate for a lettuce crop and will benefit from a basal application of up to 80 kg/ha P.

Potassium is low ideal level is at lest 5% of cations and crop removal levels for a 30 t/ha crop is about 75 kg/ha. I suggest applying in excess of 100 kg/ha of potassium per crop.

Calcium and Magnesium: Calcium is adequate but magnesium is slightly low. I suggest monitoring crop Mg levels using leaf analysis.

Micronutrients: All plant micronutrients except Mo are low and may need to be applied to the crop as a basal application or through foliar sprays. The key ones to apply are boron, manganese, copper and zinc.

Processing Capability & Consumer Suitability

The harvested material was shipped from the production regions to processing plants in Brisbane, Queensland and Bairnsdale, Victoria for an assessment of suitability as a processing input.

Supply Chain

Iceberg and cos were harvested directly in to Chep FB2 bins, stacked 3 high with a plastic sheet tapped over the top of each one. Spinach was harvested into Chep 60l crates and stacked 36 crates to a pallet with a plastic sheet covering the top layer of the pallet. All products where weighed then loaded onto a refrigerated trailer within 2 hours of harvesting. The trailer is then taken to a cold room where the products were held in 2-4 degrees overnight before shipping the next morning. This was the case on both sites and is general practice on most lettuce farms. The products were shipped on a standard refrigerated semi trailer at 2-4 degrees.

Quality

The most common quality findings were wilting, breakdown and excess dirt across all crop types. Below is a summary table of all conventional product deliveries to the Bairnsdale processing plant:

Product	Accepted	Commercially accepted	Rejected	Summary of quality issues and product performance
Iceberg	7	6	2	Iceberg quality was average to poor. Dense heads and small size caused very low yield for processors. This was put down to the fertiliser program and an ever evolving water management program. The owners of the project paid particular attention to water and nutrition management and the plan is still changing as new information arises and problems addressed.

Cos	7	9	5	Overall, Cos quality was average. Excess dirt and wind rub were the major issues. It seems the dirt is picked up early in the life cycle by the high winds and loose soil on the site. The wind also causes wind rub particularly on the outer leaves which is a quality issue for processors and wholesalers. Core length also became a problem during the hotter weeks of January and February. This minimised yield for the processors and is undesirable.
Spinach	20	4	4	Overall, Baby spinach quality was good. The major quality issue was excess dirt in the product caused by the high winds at the production site. This can sometimes be managed in the washing process but often becomes too time consuming for the processors. Cross contamination in the wash tubs is also an issue with excess soil on product

Overall, the organics results were very similar or better than conventional. In most cases, where the product was accepted and used for processing, organics were more robust, hardier, had stronger cell structure and had longer shelf life than conventional. The same growing performance pressures were apparent in both conventional and organic, particularly yield in whole head. Below is a summary of all organic deliveries into Vegco:

Product	**Accepted**	**Commercially accepted**	**Rejected**	**Summary of quality issues and product performance**
Iceberg	6	7	1	Iceberg quality was average to poor. Small sizes caused very low yield for processors. This was put down to the evolving growing and water management program.
Cos	8	7	6	Oxidisation and pinking occurred. Less wind rub was apparent (but this was put down to physical location of the site being mostly protected from the wind). Low yield was the determining factor. The project team believe this will improve with experience.
Spinach	11	11	5	Insect damage, wilting, weeds, bruising, browning. Weeds were the biggest issue. The processors zero tolerance for weeds, made the spinach very difficult and expensive to harvest. This issue needs to be resolved before large scale production of organic spinach is pursued.

It should be noted at this point that the results of the lettuce project (VG03092) and babyleaf project (VG05068) were used as a guide for the likely best practice growing and supply chain of conventional produce. For organics, the guide was developed with the combined input of the project advisors, the processors and desktop research. As expected, the practices have evolved to suit the particular blocks chosen and will continue to be developed for the life of the project. Appendix 1 details the latest Horticultural Management Plan for conventional and organic growing respectively.

Apart from a very small number of supply cold chain issues, all products, conventional and organic, were delivered between 2 & 4 degrees Celsius.

Technology Transfer

The IP developed around the project will relate to general “know-how” about salad leaf production of both conventional and organic products in semi-arid regions and regions outside the traditional areas.

There are no known patents or copyrights affecting the outcomes of this project.

The know-how derived from this project will be disseminated to contracted growers through on-site visits to the location and publication of this report.

The media summary, technical summary and full report are available at http://www.oneharvest.com.au/content/?id=217

Results

Study Tour

The study tour influenced the trial set up and growing practices. The following was taken into account when deciding on a trial site:

Set up

- Night time cooler temperatures are more important than day time maximums when choosing a site. The ideal night time temperature is 12 degrees C (this is in line with AHRs optimal range).
- Hot temperatures do not have a negative affect on the crop (within a certain range). What negatively affect a crop are hot temperature spikes.
- Cos is very difficult to grow in a high rainfall environment. Mount Gambier is very wet in the winter months but has ideal summer and shoulder period temperatures.
- Its not essential to own land - 90% of the land used for growing in California and Arizona is leased.
- Processors or retailers can utilise a cost + model to secure supply - ie. 50/50 split on all costs and profit. This can be helpful as often a grower needs finance and a processor needs security of supply. This method could encourage existing growers to extend their operations into other regions.
- Trickle irrigation saves water without affecting the quality of the product - This technique was not initiated due to the plentiful water in Mount Gambier and the existing irrigation systems set up in on the organic site in Bairnsdale. Also, in Australia overhead irrigation is often used for wind management. Trickle system do not offer protection from the wind. The farms visited always used overhead irrigation up until germination stage.

Growing

- Iceberg is less sensitive to inputs than cos
- All lettuce is direct seed – this is very different to Australia. The project has not direct seeded whole head lettuce however plans to trial it in the near future. It was said that a transplanted lettuce does not create a deep enough tap root and direct seeding was cheaper
- Transplants did not require as much water as direct seeded lettuce
- Heating the ground before seeding was essential for good germination. The growers visited would bedform at an angle toward the sun then flatten the bed just before seeding

Harvesting

- Cold chain - best practice field to cooler in 2 hours. If this is not possible, all product is vac cooled
- Quality assessment – most effective and cheapest when done in the field
- Better shelf life was achieved when product was harvested during the cooler hours of the day. Most companies visited harvested between midnight and 8am

Organics

- It costs 30% more to grow organics – this is reflected in the price however
- Organic fertiliser is 100% more expensive than conventional fertiliser
- The majority of companies visited were converting land that had been lay fallow for a number of years
- Cheap land is essential due to the time it takes to convert to certified organic
- If the companies cannot find a market for the organic product, they sell it as conventional
- Organically grown product yields the same as conventional
- The biggest issue for organic farming is weed control. The most popular method for controlling weeds is “solarisation”. Clear plastic is put on the beds for up to 3 months at the hottest time of the year killing most of the weed seeds.
- Most farms grew a row of “beneficials” every 3 rows to deter insects from the crop

Site Evaluation

The following pages detail the site evaluation results. They compare regional climatic data from the Australian Bureau of Metrology with the optimal germination and growth parameters of Baby-leaf Spinach (Spinacia oleracea) and Lettuce (Lactuca saliva) growing in Australia. More data can be found in Appendix 4 - Daily Maximum and Minimum Temperature. Industry can use this data to make decisions on where and when Spinach and Lettuce is likely to grow successfully.

Optimal germination and growth parameters of Baby-leaf Spinach (Spinacia oleracea)

	Germination (^{o}C)	**Growth (^{o}C)**	**Mapping limits**
Min	2	5	Min. = 2
Optimum range	7-24	15-18	Max. night = 15
		(14-24 for maximum quality)	
Max	30 **	32	Max. = 30

Notes:

1. soil temperature above 30^{o}C. for germination is a limiting factor
2. 14-24^{o}C. growth for maximum quality
3. > 20^{o}C. reduces yield through higher plant respiration.

Optimal germination and growth parameters of Lettuce (Lactuca saliva)

	Germination (^{o}C)	**Growth (^{o}C)**	**Mapping limits**
Min	2.2	7	Min. = 7
Optimum range	18-21	12-21	Max. night = 15
Max	27 **	24	Max. = 24

Notes:

1. high temperature dormancy above 27 ^{o}C is a limitation

2. germination at 0 ^{o}C = 49 days, and at 5 ^{o}C = 15 days (see optimum range)

** = limiting factors

Projected Growing Slots for new and existing growing regions

Lettuce – growing slots x regions (harvest times)

Lettuce

QLD	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Comments
Maroochydore													
Rockhampton													too hot
Mackay													
Millaroo													too hot
Emerald													too hot
Pittsworth/Brookstead													slightly too cold in winter
Inglewood													too cold in winter/too hot summer
Gympie													
Warwick													really too cold in winter
Bundaberg													
Bowen													too hot
Atherton													
Gatton (Lawes)													
Toowoomba													slightly too cold in july
Beechworth													
Stanthorpe													too hot in summer - marginal

NSW	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Comments
Bellingen													slightly cold in july
Kempsey													
Southwest rocks (Stuarts Point)													good climate for winter lettuce
Coffs harbour													colder than Stuarts Point
Waughope													
Taree													
Cessnock													marginally too cold in July-Aug
East Maitland (Tocal)													
Nowra													good potential
Robertson (Mittagong)													slightly hot in Jan
Murwillumbah													
Lismore													
Bega													
Sunny Corner, NSW													marginally hot in Jan
Milthorpe, NSW													
Albury													
Griffith													winter possible but really too cold
Hillstone													
Oberon													good potential for summer
Camden													winter really too cold
Guyra													good summer climate
Condobolin													too cold in winter
Canowindra													too hot summer / too cold winter
Gayndah													
Tumut													
Hay													winter possible - really too cold
Orange													
Bathurst													
Cooma													summer possible - really too hot
Tumbarumba NSW													too hot summer / too cold winter

Victoria	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Comments
Orbost													marginally hot in Jan and Feb
Cranbourne													good climate - slightly hot in Feb
Sale													
Rochester													
Boort													
Echuca													
Mildura													marginally too cold in july
Colac													
Bairnsdale													really too hot in Jan and Feb
Robinvale (Wemen)													too cold in June and July
Gundagai													
Warrnambool													excellent climate for lettuce
Maffra													too hot in Feb
Werribee (Laverton)													marginally hot in Jan/Feb cold July
South Australia	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Murray Bridge, SA													water ?
Mt Gambier													slightly cold in july
Tasmania	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Forth													good summer climate
Hobart													
Swansea (Tas)													
Northern Territory	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Katherine													too hot
Ti Tree (Barrow Creek)													
Middle Point (Humpty Doo													too hot
Western Australia	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Wanneroo													good winter climate
Albany													good climate -marginally hot in Jan
Denmark													good climate -marginally hot in Jan
Manjimup													summer too hot
Kununurra													too hot
USA	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Yuma, AZ													
Salinas, CA													on the 8th day…

Spinach growing slots x regions (harvest times)

Spinach

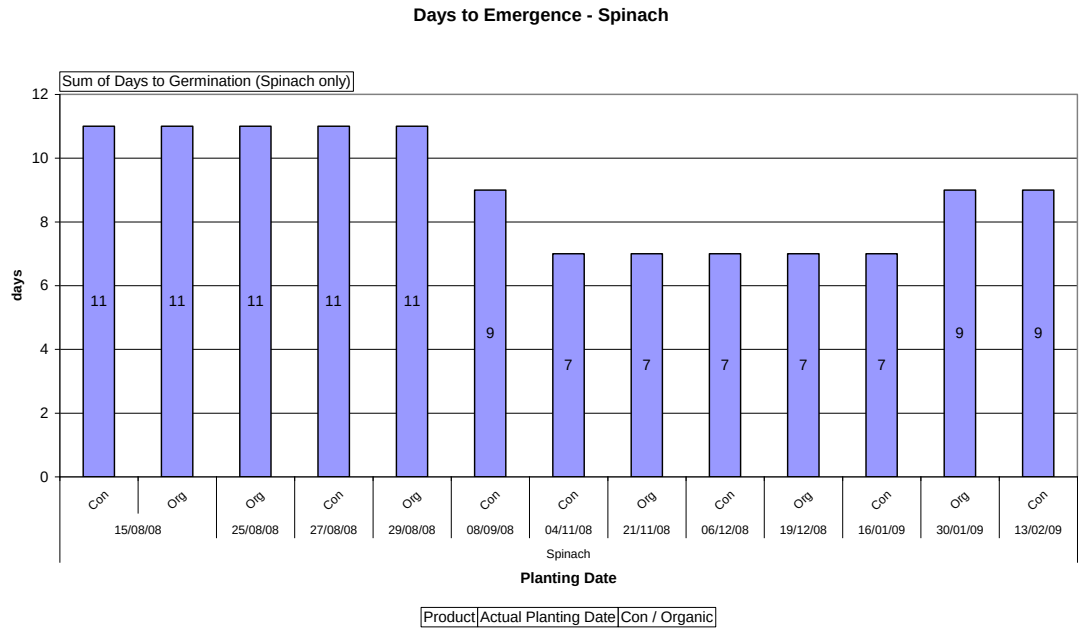
QLD	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Comments
Maroochydore													
Rockhampton													
Mackay													
Millaroo													
Emerald													
Pittsworth/Brookstead													
Inglewood													winter possible but really too cold
Gympie													marginally hot in Dec and Jan
Warwick													winter possible but really too cold
Bundaberg													
Bowen													
Atherton													
Gatton (Lawes)													marginal summer
Toowoomba													
Beechworth													
Stanthorpe													

NSW	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Comments
Bellingen													
Kempsey													
Southwest rocks (Stuarts Point)													
Coffs harbour													
Waughope													
Taree													
Cessnock													
East Maitland (Tocal)													
Nowra													
Robertson (Mittagong)													
Murwillumbah													
Lismore													
Bega													
Sunny Corner, NSW													
Milthorpe, NSW													
Albury													
Griffith													
Hillstone													
Oberon													
Camden													
Guyra													
Condobolin													
Canowindra													
Gayndah													
Tumut													
Hay													
Orange													
Bathurst													
Cooma													
Tumbarumba NSW													

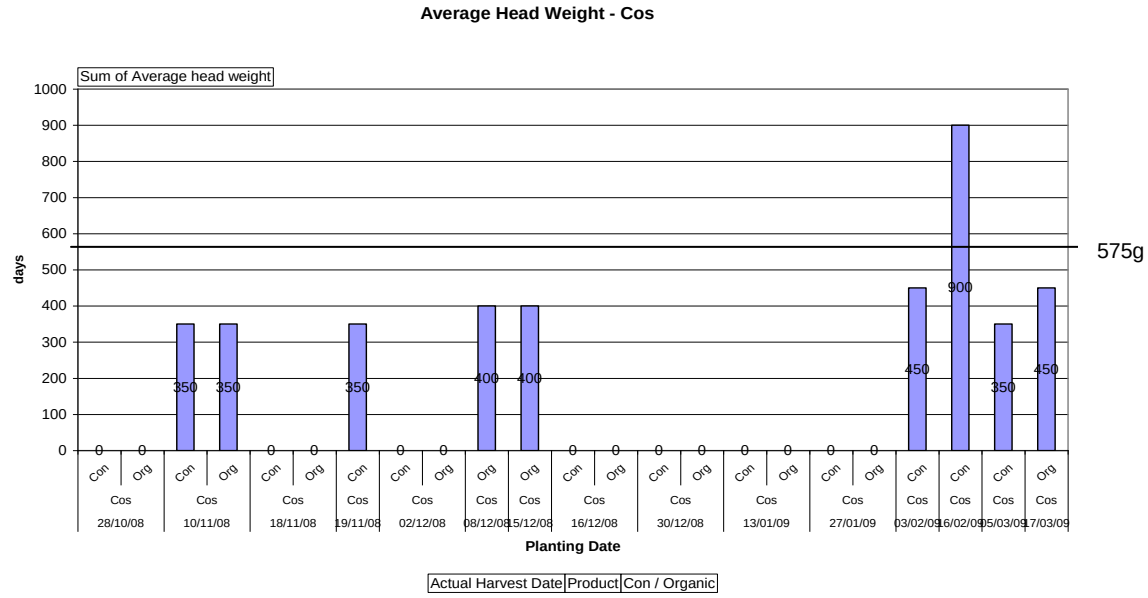
Victoria	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Comments
Orbost													
Cranbourne													
Sale													
Rochester													
Boort													
Echuca													
Mildura													
Colac													
Bairnsdale													
Robinvale (Wemen)													
Gundagai													
Warrnambool													
Maffra													marginally cold in July
Werribee (Laverton)													
South Australia	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Murray Bridge, SA													
Mt Gambier													
Tasmania	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Forth													
Hobart													
Swansea (Tas)													
Northern Territory	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Katherine													too hot
Ti Tree (Barrow Creek)													too hot other times
Middle Point (Humpty Doo													too hot
Western Australia	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Wanneroo													
Albany													
Denmark													
Manjimup													
Kununurra													too hot
USA	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Comments**
Yuma, AZ													
Salinas, CA													

Evaluation of Pilot to Prove Trials

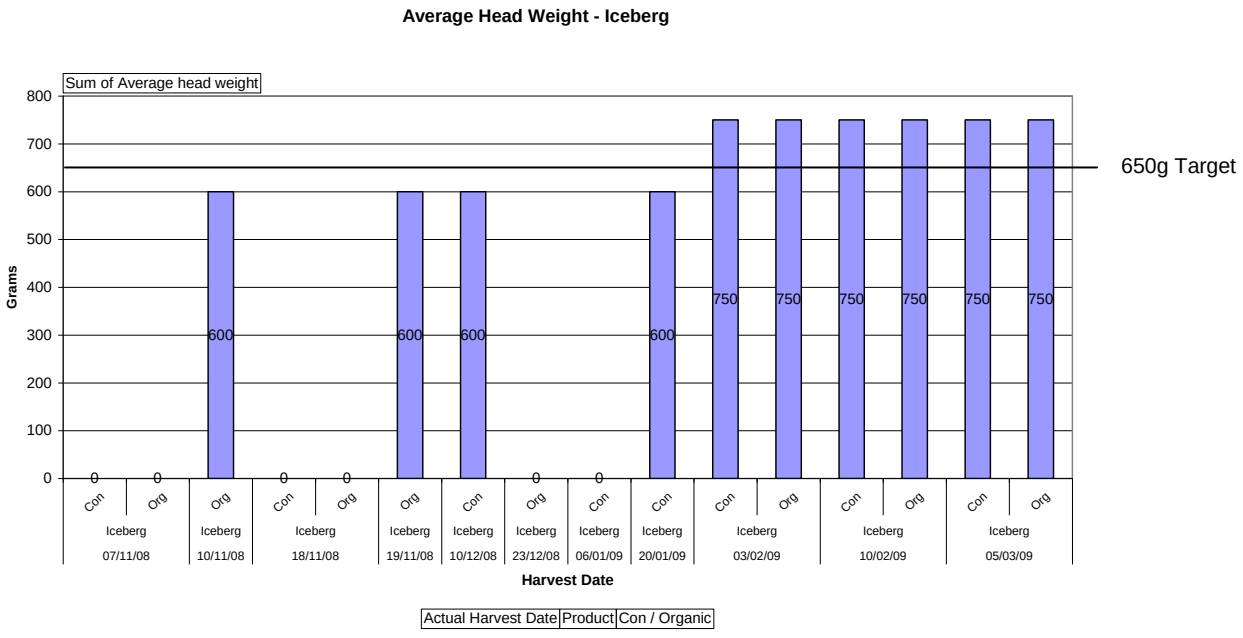
The table below shows days to emergence for organic and conventional spinach. As expected, the cooler months show 9-11 days decreasing to 7 days in the hot summer months of November, December and January. As can be seen in this graph and the following graphs, growing lettuce and baby organically or conventionally in the majority of cases does not change the fundamental key indicators of product performance like days to emergence, average head weight and days to harvest.



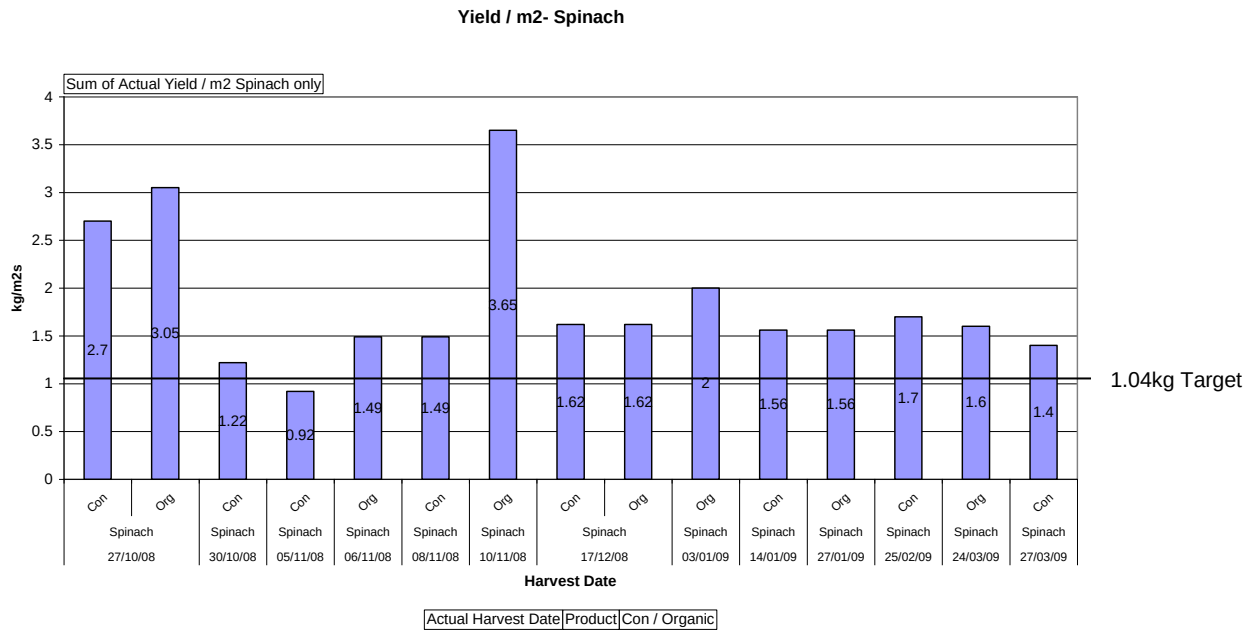
The table below outlines the average head weight of Cos. The target was 575 grams. For the reasons detailed in the Best Practice Evaluation section of this report, cos performance was average. The results below illustrate this. A cos operation would need to consistently average 575 grams to be competitive in the marketplace.



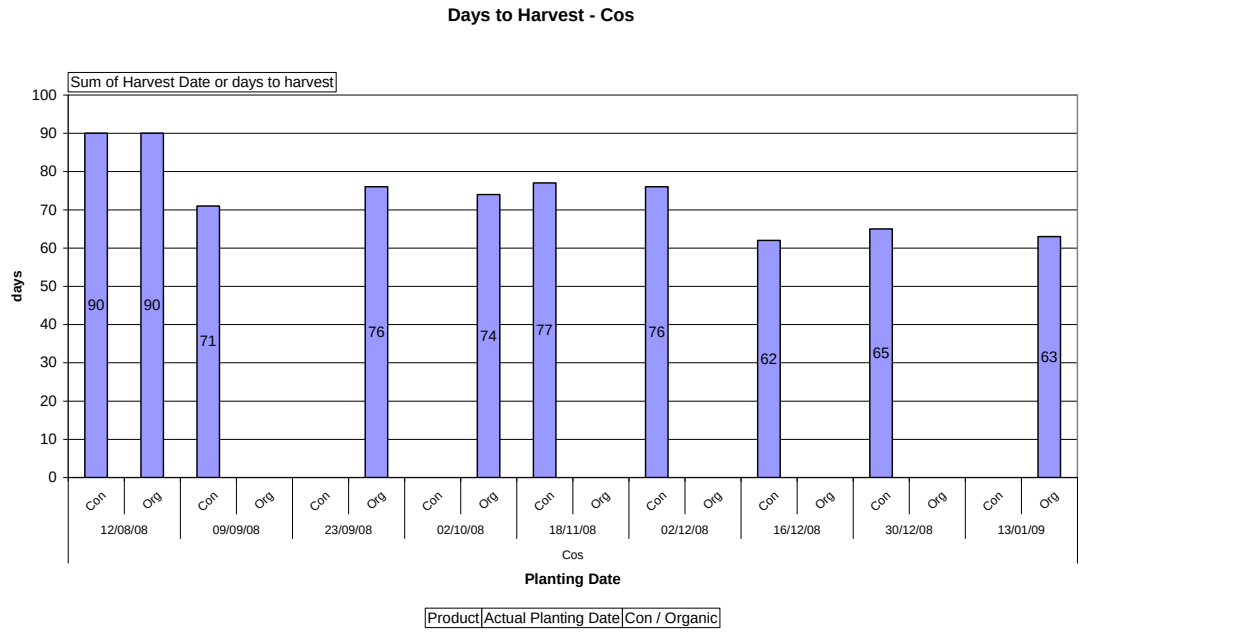
The graph below outlines the average head weight for conventional and organic iceberg. Although the target weight was reached on a number of occasions, the density of the product was far too great to be accepted by a processor or retailer.

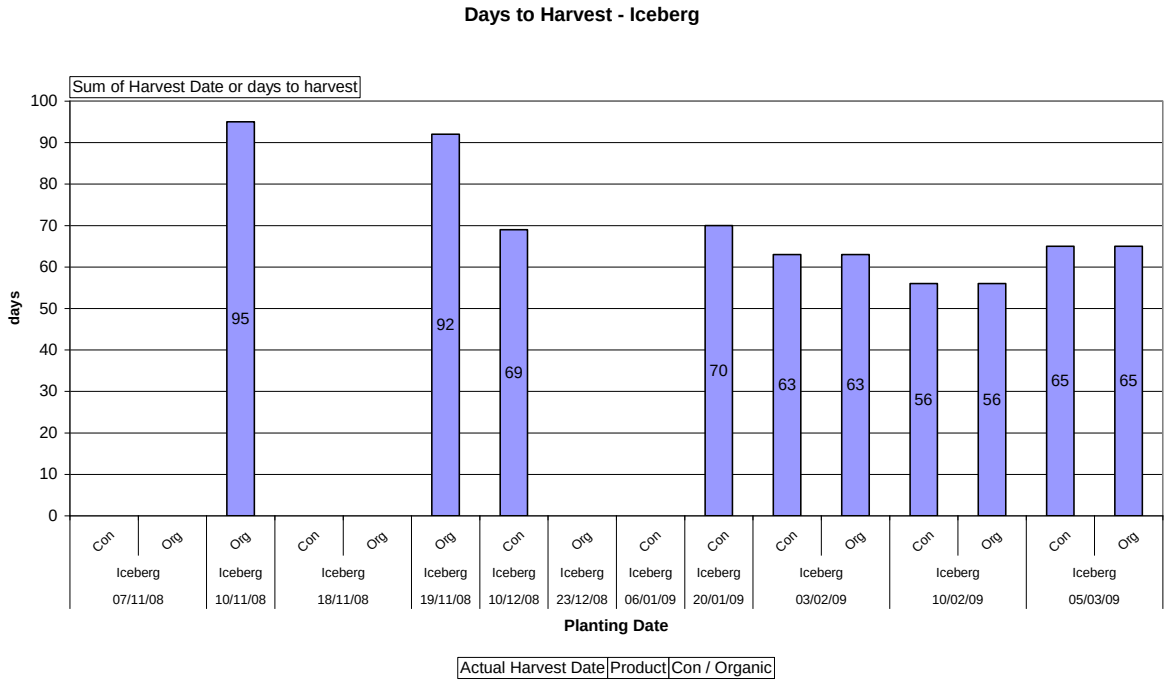


Spinach yield was outstanding on both organic and convention. The graph below shows the results.

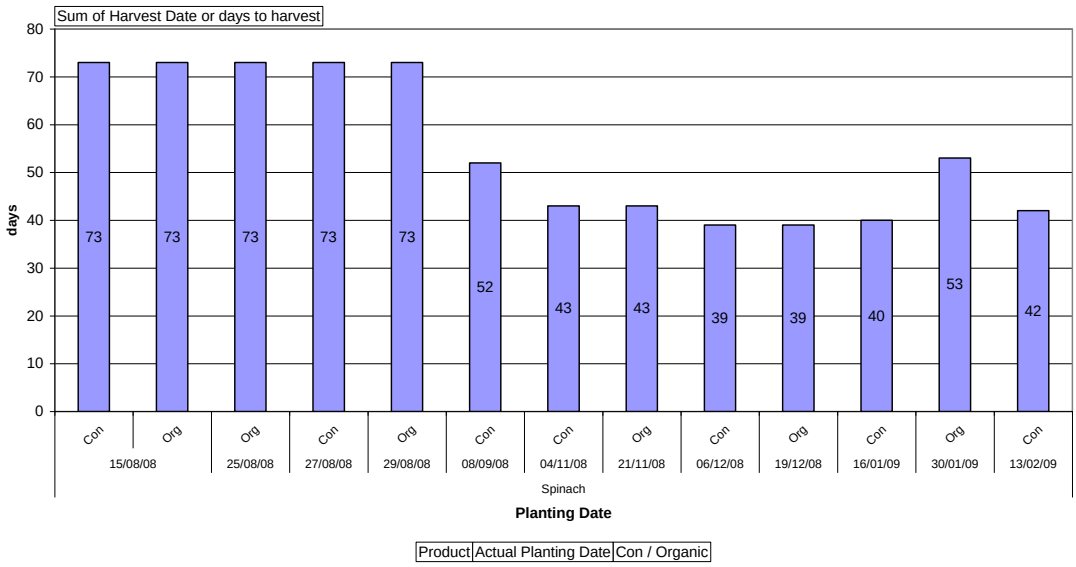


Again, no substantial difference in days to harvest for organic and conventional cos and iceberg. The warmer months produced industry standard results while the cooler months produced longer than expected results mainly due to the lack of daylight hours in the winter in the southern states.





Days to harvest for spinach was slightly greater than expected but not outside the industry standards or what can be expected in a new area. As mentioned previously in this report, spinach grew and yielded very well using growing techniques growers in traditional areas would incorporate.



Discussion

During the project, and later after analysing the data, it was found that despite the different methods of growing, the organic and conventionally grown products had very similar characteristics. This was not surprising to the project team. The data on the tables above show these similarities. The project team believe this is a very important finding. Assuming the same varieties are used (which is the case for this project), and assuming no significant circumstances wiping out the crop, conventional and organically grown lettuce and baby leaf produce very similar yield and growth cycle results.

By product, comments from the Farm Manager:

Cos (Lactuca sativa)

- Standout variety is Avidius, although some of the darker varieties are making it to harvest now
- It has not grown as well as expected. This is attributed to transplanter issues, soil imbalances and water quality. All of these are solvable problems.
- Some bolting issues occurred after a hot spell
- It struggled to establish into a strong plant and frame, leading to low weights and head density
- Issues encountered with wind rub, leaf margin cracking (nutritional) and soil contamination
- No major disease problems observed; anthracnose was observed after heavy rain (soil splash)
- No mildew problems in Avidius
- Some dropping off (sample showed Rhizoctonia)
- No major insect issues that caused damage, some insects present as contaminants (as per all crops) – hoppers, bugs, spiders etc
- Crops have shown major improvements through season, although there are some major hurdles still to overcome

Iceberg (Lactuca sativa)

- Average performance. It appears to be more sensitive to soil/water/planter issues than Cos.
- If other issues are overcome, mildew will still be a major factor to be managed, although it might be less of a problem if plants are stronger and healthier
- Soil contamination and anthracnose as per Cos

Spinach

- No stand out varieties; no major disappointments
- Problems observed were yellowing in the conventional product (early on due to nutrition programme) – the crop responded to nutrition changes that were implemented
- Minor insect problems on mature leaf, minor insect damage on young plants that caused leaf distortion, damping off during/after hot spell (probably due to amount of irrigation)
- Weeds were a problem, particularly in the organic block

Where to from here?

Mount Gambier –

- Production on the site is continuing and is planned to supply 10% of Harvest Fresh Cuts summer requirement by 2010-11
- Iceberg has been dropped from the product range to concentrate on Cos and spinach
- The team continues to be trained in the necessary skills needed to run a successful lettuce farm
- Approximately 8 tonne / week of conventional baby leaf and whole head lettuce will be harvested between the October 2009 and May 2010
- It is unknown if new or existing growers (outside of Oolloo Farm Management) are likely to be taking up production in any of the areas identified in this report.

Organics -

- The market for organics is growing while at the same time growers find new and improved ways of growing organics more costs effectively.
- Organic production will continue on the Bairnsdale site. It is expected that the production of organic lettuce on this site will increase by 10-15% this coming financial year and will expand to coral lettuces and rocket.
- The Mount Gambier site will not be converted in the next 12 months. The project team will focus on improving the soil, processes and skills of the team before it starts the organic conversion process. Conversion on the current site will be investigated in the early part 2010.
- Since the projects inception, organic land in the Mount Gambier area used for potato production has been identified and will be assessed immediately. It is planned that by 2010, the site will be producing commercial quantities of organic lettuce. Exact quantities will be established once land is tested and secured

Technology Transfer

With the research completed and data captured in this project, industry can confidently expand its growing base to include regions that traditionally are not used for lettuce production and successfully grow organic and conventional products. While at the same time spreading its water management risk and decreasing the likelihood of a food safety issue due to water contamination.

This report is available on a dedicated webpage http://www.oneharvest.com.au/content/?id=217 and will be sent to Harvest Fresh Cuts grower base. This website is available to the public.

The report findings will be discussed at length in each of Harvest Fresh cuts yearly grower “Shared Objective Plan” meetings. These meetings are a powerful tool used to align Harvest Fresh Cuts customer plans with the producers allowing the whole supply chain to share in any benefit gained from growth with customers. As indicated from the outset of this project, the fresh cuts industry is under threat from lack of safe water supply and the Mount Gambier operation and the organic trials in Bairnsdale can be used as a showcase for other growers to expand into new areas. 3 of Harvest Fresh Cuts largest growers have visited the Mount Gambier site and as mentioned previously, organic production on the Bairnsdale site will be expanded. It is now at the growers discretion to invest in new areas, Harvest Fresh Cuts will be encouraging this expansion during these planning meetings.

This report provides the information industry can adopt to have the most chance of success when trialling a new area, then perhaps eventually developing it into a full scale commercial operation.

Recommendations

- There are many potential regions outside of the traditional growing areas with good, clean water supply that with the right management could produce high quality profitable product
- No one area is a “silver bullet”. All potential locations have advantages and disadvantages across all aspects of growing ie. pest and disease, nutrition, variety selection, weather conditions, soil suitability, contamination, labour, supply chain logistics
- Suitability on green field sites - paying particular attention to many years of super phosphate applications and other agricultural purposes and the implications that come with cropping after so much use
- The majority of the suitable blocks identified in the regions that have the potential to become lettuce production regions have been used for agriculture and horticultural activities rendering the fast tracking of organic certification unachievable
- Variety selection criteria for green field sites and subsequent trialling regime
- Training programs in conjunction with TAFE’s, universities and/or other training institutions for lettuce production in these areas could encourage more investment into these crops
- From a food safety point of view, adherence to SaladGAP guidelines is very important. Particularly as many of the potential growing regions have historically been used for agriculture
- Be very diligent in variety selection. What works in one region may not work in another
- Assess supply chain costs before making any big investment. Many of the potential areas are not traditionally lettuce growing regions and therefore do not have the distribution networks set up to handle cold chain
- Similar to distribution, if a larger scale operation is implemented, industry needs to aware that because some of these regions are not traditionally used for lettuce production, skilled labour is an ongoing issue and suitable training needs to be addressed.
- Soil and water analysis and product trials in other suitable regions indicated earlier in the report

Acknowledgments

The project team would like to thank the following organisations for their input into this project:

- HAL
- Applied Horticultural Research
- Britton Produce
- Oolloo Farm Management
- Greenbanks Farms
- Mingbool Pastoral Company

Appendix 1 – Horticultural Management Plans

ICEBERG & COS – CONVENTIONAL – HORTICULTURAL MANAGEMENT PLAN

Growth Stage	Pre Planting	Plant Establishment	Plant Establishment	Plant Growth	Plant Growth	Plant Growth	Plant Growth	Plant Growth	Harvest
Approx timing	Summer	Drill	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	
Fertilising									
Application									
In Bed Fertilise									
Drop		Rustica 400kg/ha			Gold Plus 250kg Ha				
Fertigate							Ca N+ Zn 50kg/ha	Ca N 50kg .ha	
Foliar		Mg Chelate 1lt Ha		Foliar result 2lt Ha	Foliar Result 2lt/ha	Foliar Result 2lt/ha	Foliar Result 2lt/ha	Chelated Mg (optional) 1lt ha	

Approx	Summer	Transplant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 6
Timing									
Herbicides		Kerb 4lt/ha							
Fungicides				Dithane		Champ	Champ	Champ	
Insecticides	Summer		Dimethoate 7 Day	Dimethoate	Pyromil	Dimethoate			

SPINACH – CONVENTIONAL – HORTICULTURAL MANAGEMENT PLAN

Growth Stage	Pre Planting	Plant Establishment	Plant Establishment	Plant Growth	Plant Growth	Plant Growth	Plant Growth	Harvest
Approx	Summer	Seed	Week 1	Week 2	Week 3	Week 4		
Timing	Winter		Week 3	Week4	Week 5	Week 6		
Fertilising								
Application								
In Bed Fertilise								
Drop		Rustica plus 400kg ha						
Fertigate					Ca N + Zn 50kg Ha	Ca N 50kg ha		
Foliar				Foliar Result 2lt/Ha	Foliar Result 2lt/ha	Chelated Mg (optional) 1lt ha		

Approx	Summer	After Seeding	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Timing	Winter		Week 3	Week4	Week 5	Week 6	Week 7	Week 8-10
Herbicides		Duall Gold 200ml/ha						
Fungicides				Ridomil 2.5kg/HA 14day WHP	Copper Oxydul 2kg/HA 1day WHP			
Insecticides	Summer	Spray 1	Dimethoate 7 Day	Dimethoate (750ml ha)7day early week	Dimethoate 7 Day	Success 3 Day		

SPINACH – ORGANIC - HORTICULTURAL MANAGEMENT PLAN

Growth Stage	Pre Planting	Plant Establishment	Plant Establishment	Plant Growth	Plant Growth	Plant Growth	Plant Growth	Harvest
Approx	Summer	Seed	Week 1	Week 2	Week 3	Week 4		
Timing	Winter		Week 3	Week4	Week 5	Week 6		
Fertilising								
Application								
In Bed Fertilise			500kg/ha Organic Booster					
Drop / Spread	2.5 tonne /Ha Lime, 100kg/Ha Potash, 100kg/Ha Magnesium Sulphate	5 Tonne /Acre Chicken manure						
Fertigate								
Foliar				Seasol 4L/Ha	6 L/Ha Blood and Bone	6 L/Ha Blood and Bone		

Approx	Summer	After Seeding	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Timing	Winter		Week 3	Week4	Week 5	Week 6	Week 7	Week 8-10
Herbicides								
Fungicides								
Insecticides	Summer			Natra Soap 6 L/Ha, Pyganic 1.2L/Ha	Entrust 95g/Ha	Entrust 95g/Ha		
Insecticides	Summer							
Insecticides	Winter			Natra Soap 6 L/Ha, Pyganic 1.2L/Ha		Entrust 95g/Ha		Entrust 95g/Ha

ICEBERG AND COS – ORGANIC – HORTICULTURAL MANAGEMENT PLAN

Growth Stage	Pre Planting	Plant Establishment	Plant Establishment	Plant Growth	Plant Growth	Plant Growth	Plant Growth	Harvest
Approx timing	Summer	Transplant	Week 3	Week4	Week 5	Week 6		
Fertilising								
Application								
In Bed Fertilise			500kg/ha Organic Booster					
Drop / Spread	2.5 tonne /Ha Lime, 100kg/Ha Potash, 100kg/Ha Magnesium Sulphate	5 Tonne /Acre Chicken manure						
Fertigate								
Foliar				Seasol 4L/Ha	6 L/Ha Blood and Bone	6 L/Ha Blood and Bone + Seasol 4L/Ha		

Approx Timing	Summer	After Seeding	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Herbicides								
Fungicides				copper application		copper application		
Insecticides	Summer			Natra Soap 6 L/Ha, Pyganic 1.2L/Ha	Entrust 95g/Ha	Entrust 95g/Ha		

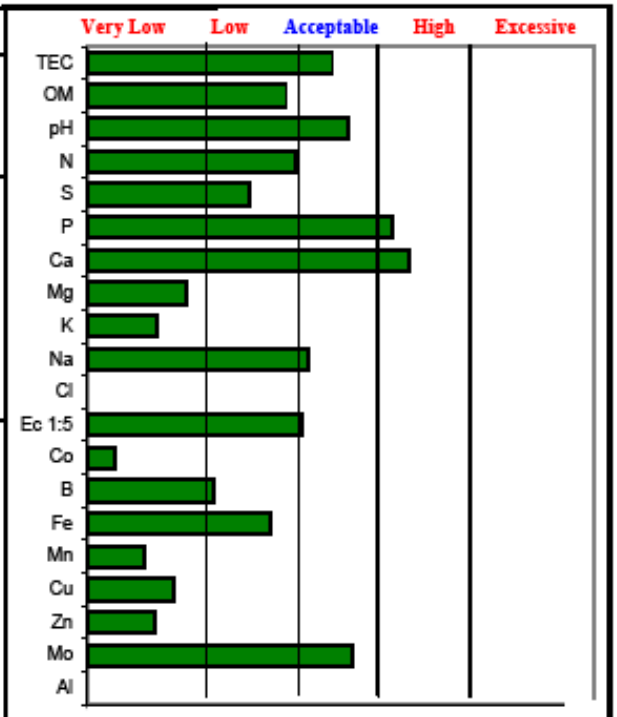
Appendix 2 – Soil Analysis

Australian Perry Agricultural Laboratory

Control 13861

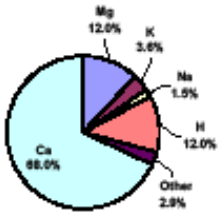
Customer: BRITTON PRODUCE
Advisor: MOUNT GAMBIER - ELDERS LIMITED
Sample Name: KIRBY - RANDWICK
Crop: DRYLAND PASTURE
Lab No.: B0031 **Date:** 29-Aug-07

		Unit	Desired Level	Level Found
	Total Exchange Capacity (TEC)		12-25	17.12
	Colloidal Organic Matter %		4.0 - 6.0	3.70
	PH (Water)		6.0 - 6.5	6.30
Anions	Nitrogen (N)	kg/ha	90 - 120	87
	NO 3	ppm		*
	NH 3	ppm		*
	Sulphate (S)	ppm	20 - 30	15
	Olsen (P)	ppm	18-28	19
	Phosphorus (Bray 2)	kg/ha	124	177
	Deficit	kg/ha	Units P	0
	Phosphate Recovery	%	100	72
Cations			ppm	kg/ha
	Calcium (Ca)	Desired	2327	5229
		Found	2648	5951
		Deficit		0
	Magnesium (Mg)	Desired	246	554
		Found	105	235
		Deficit		319
	Potassium (K)	Desired	240	540
		Found	65	145
		Deficit		395
	Sodium(Na)	Found	36	80
	Chlorides (Cl)	ppm	<250	*
	Salinity EC 1:5	dS/m	<0.15	0.05
Trace Elements	Cobalt (Co)	ppm	>1.5	0.20
	Boron (B)	ppm	>0.8	0.88
	Iron (Fe)	ppm	100 - 400	68.00
	Manganese (Mn)	ppm	80 - 140	16.00
	Copper (Cu)	ppm	>2.0	0.80
	Zinc (Zn)	ppm	>8.0	2.50
	Molybdenum (Mo)	ppm	0.8 - 2.0	1.60
	Aluminium (Al)	ppm	<2.0	*
Base Saturation %	Ca:Mg RATIO		5.67	15.18
	Calcium	% Ca	68.0	77.4
	Magnesium	% Mg	12.0	5.1
	Potassium	% K	3.6	1.0
	Sodium	% Na	1.5	0.9
	Other Bases	%	2.9	5.1
	Exchangeable Hydrogen	% H	12.0	10.5

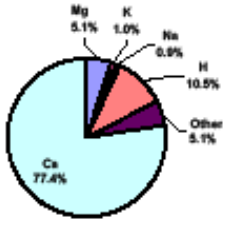


Base Saturation Percentages

Desired



Found



Additional Comments: Cobalt *Limit of Detection* 0.2 ppm

The following show the kg/ha of deficient elements required to bring the soil to the ideal level:

PHOSPHOR	nd	BORON	1.2	COBALT	1.3
MAGNESIUM	319	IRON	24	MO	nd
POTASSIUM	395	MANGANESE	88		
CALCIUM	nd	COPPER	2.4		
SULPHUR	15	ZINC	11.0		

* This test is available but not requested by client. nd = not deficient n req = not requested

APAL, PO Box 489 The Parade, MAGILL, SA 5072. Tel. 08 8332 0199 Fax. 08 8361 2715

Appendix 3 – Weather Data

Min Max temp, rainfall and daylight hours for Mount Gambier Aero – approx 15kms from production sites

Date	Day	Temps		Rain	Sun
		Min	Max		
		°C	°C	mm	hours
1-Jul-08	Tu	8.2	13.1	19.8	4.9
2-Jul-08	We	10.4	12.7	1.6	0.6
3-Jul-08	Th	8.1	13	0.2	2.4
4-Jul-08	Fr	3.2	12.7	0	4.4
5-Jul-08	Sa	5.3	12.8	0	5
6-Jul-08	Su	7.5	14.6	0	7.2
7-Jul-08	Mo	8.1	11	7.4	1
8-Jul-08	Tu	5.8	11.7	14.4	5.4
9-Jul-08	We	4.3	12.8	0.2	0.8
10-Jul-08	Th	5.6	10.6	7	4.2
11-Jul-08	Fr	6.2	11.4	4.8	3.3
12-Jul-08	Sa	5	10.7	0.2	1.4
13-Jul-08	Su	5.9	15.8	0	7.6
14-Jul-08	Mo	4	12.5	0	1.1
15-Jul-08	Tu	7.2	12.7	3.8	0.3
16-Jul-08	We	3.9	12.8	0.4	0.5
17-Jul-08	Th	6.5	12	0.6	3.5
18-Jul-08	Fr	5.5	12.4	7.2	7
19-Jul-08	Sa	4.6	12.8	0.4	2.6
20-Jul-08	Su	6.2	14.5	0.8	4.9
21-Jul-08	Mo	7.9	12.2	6	6
22-Jul-08	Tu	4.3	11.7	0.8	3.6
23-Jul-08	We	-0.1	12.4	0	6.3
24-Jul-08	Th	1.1	12.1	0	8.5
25-Jul-08	Fr	4.2	14.1	0	8.3
26-Jul-08	Sa	4.7	12.1	2.2	3.9
27-Jul-08	Su	2.7	11.1	4.8	5
28-Jul-08	Mo	-0.4	13.2	3.8	7.8
29-Jul-08	Tu	0.1	9	0.2	0.8
30-Jul-08	We	3.4	14	0.4	2.7

31-Jul-08	Th	4	15.6	2.2	3
1-Aug-08	Fr	7.6	12.2	10.6	6.4
2-Aug-08	Sa	6.3	14	1	6.5
3-Aug-08	Su	5.8	14	0.6	3.7
4-Aug-08	Mo	6.2	15.3	0.4	6.8
5-Aug-08	Tu	1.2	15	2.2	8.5
6-Aug-08	We	5.3	12.9	0	1.6
7-Aug-08	Th	6.6	11.3	11.2	6.7
8-Aug-08	Fr	4.3	11.9	1.8	4.5
9-Aug-08	Sa	2.7	10.5	0.6	3.5
10-Aug-08	Su	2.6	10.4	19.6	7.3
11-Aug-08	Mo	4.1	12.2	2.4	5.9
12-Aug-08	Tu	4.3	11.5	3.8	5.3
13-Aug-08	We	1.2	10.8	4.4	3.7
14-Aug-08	Th	6	11.9	0.4	3.5
15-Aug-08	Fr	7.6	12.7	1	1.4
16-Aug-08	Sa	7.4	13	5.2	8.8
17-Aug-08	Su	8	13.1	2.2	6.6
18-Aug-08	Mo	4.5	14.1	0.8	9.3
19-Aug-08	Tu	5.7	13.5	0	1.2
20-Aug-08	We	9.7	14.8	4	5
21-Aug-08	Th	6.7	12	15.8	6.3
22-Aug-08	Fr	2.6	12.2	6.6	8.8
23-Aug-08	Sa	2.5	12.7	1	6
24-Aug-08	Su	3.7	12	0.2	0.6
25-Aug-08	Mo	6.2	14.8	1	5.3
26-Aug-08	Tu	5.1	13.6	1.8	9.2
27-Aug-08	We	3	12.4	0.2	0.4
28-Aug-08	Th	4.5	14	0.2	6.3
29-Aug-08	Fr	2.7	17.2	0	7.7
30-Aug-08	Sa	8.5	12.6	0.6	0
31-Aug-08	Su	6.6	12.7	14.4	4.9
1-Sep-08	Mo	5.4	13.3	4.6	1.4
2-Sep-08	Tu	5.3	14	4.4	8.8
3-Sep-08	We	2.6	13.6	0.4	7.2
4-Sep-08	Th	0.7	16.6	0	9.7
5-Sep-08	Fr	4.9	17	0	4.9

6-Sep-08	Sa	2	15.8	0.2	9.8
7-Sep-08	Su	1.4	15.4	0	7.8
8-Sep-08	Mo	4.3	13	0	1.8
9-Sep-08	Tu	-0.4	14.3	0	9.6
10-Sep-08	We	3.4	18.1	0	9.3
11-Sep-08	Th	9.1	20	3.2	8.9
12-Sep-08	Fr	9.9	17.5	0.2	6.6
13-Sep-08	Sa	10.7	22.9	2.4	9.1
14-Sep-08	Su	7.4	14	5.2	7.9
15-Sep-08	Mo	8.3	12.9	6	4.9
16-Sep-08	Tu	5.4	12.7	9.2	5.1
17-Sep-08	We	2.4	16.3	0.2	10.1
18-Sep-08	Th	10	19.5	0	5.7
19-Sep-08	Fr	9.5	16.3	0	3.1
20-Sep-08	Sa	8.1	14.8	1.2	7.8
21-Sep-08	Su	4.8	16	4.2	6.5
22-Sep-08	Mo	10.7	12.6	1.2	1.7
23-Sep-08	Tu	4.6	14.8	7.4	9.2
24-Sep-08	We	4.4	15	1.2	1.3
25-Sep-08	Th	6.2	20.9	0	10.3
26-Sep-08	Fr	10.8	21.3	0	7.8
27-Sep-08	Sa	4	22	0	6.7
28-Sep-08	Su	6.9	15.5	0.6	6.9
29-Sep-08	Mo	2.6	13.7	1	8.7
30-Sep-08	Tu	3.8	16.4	0	6.5
1-Oct-08	We	8.4	22.4	0	3.7
2-Oct-08	Th	11.8	18.9	0.2	8.5
3-Oct-08	Fr	6.2	12.8	0	0.7
4-Oct-08	Sa	3.1	15.2	4.8	9
5-Oct-08	Su	2.9	16.7	0	11.3
6-Oct-08	Mo	6.7	13.6	4.4	9.8
7-Oct-08	Tu	7.8	14.1	0.6	4.9
8-Oct-08	We	7.9	14.8	1.8	7.5
9-Oct-08	Th	5.9	17.6	0.2	8.2
10-Oct-08	Fr	4.5	20.2	0	11.7
11-Oct-08	Sa	4	23.8	0	11.9
12-Oct-08	Su	10	28.1	0	7.4

13-Oct-08	Mo	9.9	16.2	0	10.1
14-Oct-08	Tu	2.5	15.6	0	9.2
15-Oct-08	We	6.6	15.6	0.2	0.5
16-Oct-08	Th	8.8	19	0	6.6
17-Oct-08	Fr	4.5	25.5	0.2	11.3
18-Oct-08	Sa	12.3	31.4	0	10.1
19-Oct-08	Su	11.6	17.9	0.4	7.4
20-Oct-08	Mo	5.8	16.6	0	10.6
21-Oct-08	Tu	5.2	16.4	0	9.2
22-Oct-08	We	4.4	18.2	0	11.9
23-Oct-08	Th	1.4	21.9	0	7.8
24-Oct-08	Fr	8.1	27.7	0	8.8
25-Oct-08	Sa	10.1	32.9	0	4.3
26-Oct-08	Su	14.8	29.8	0	4.1
27-Oct-08	Mo	11.5	15.5	1.6	1.1
28-Oct-08	Tu	10.7	19.4	0	7.7
29-Oct-08	We	5.6	23.4	0	10.1
30-Oct-08	Th	11.7	29.5	0	10.3
31-Oct-08	Fr	13	14	0.8	0
1-Nov-08	Sa	9.8	19.8	0.8	10.5
2-Nov-08	Su	6.6	20.9	0	0.9
3-Nov-08	Mo	9.8	16.4	5.6	5.4
4-Nov-08	Tu	8.5	18.4	0	11.7
5-Nov-08	We	8.6	22.5	0.2	7.2
6-Nov-08	Th	8.4	21.7	0	11.9
7-Nov-08	Fr	11.7	23.2	1.2	2.1
8-Nov-08	Sa	10.3	16.3	4.6	9.7
9-Nov-08	Su	11.2	18.9	2.2	2.8
10-Nov-08	Mo	12.1	21.6	0	
11-Nov-08	Tu	8.9	31.6	0	
12-Nov-08	We	11.3	34.7	0	10.3
13-Nov-08	Th	19.6	29.6	0	8.7
14-Nov-08	Fr	10.2	18.1	0.6	6.3
15-Nov-08	Sa	5	15.8	0.4	5.9
16-Nov-08	Su	7.6	18	0	10.8
17-Nov-08	Mo	1.8	20.6	0	13.3
18-Nov-08	Tu	6.1	16.7	0	0.5

19-Nov-08	We	10.5	23.9	0.2	4.8
20-Nov-08	Th	11.6	16.7	0	1.9
21-Nov-08	Fr	9.1	16.5	0.2	6.1
22-Nov-08	Sa	6.1	13.4	11.8	9.1
23-Nov-08	Su	7.6	15.9	5	1
24-Nov-08	Mo	10	19.9	0	7.4
25-Nov-08	Tu	8.5	26.2	0	10.9
26-Nov-08	We	13.9	30	0	7.9
27-Nov-08	Th	11.6	19.9	0	1.7
28-Nov-08	Fr	12.2	17.6	0.2	0.1
29-Nov-08	Sa	11.7	18.4	1.8	9.3
30-Nov-08	Su	8.4	21.7	0	7.4
1-Dec-08	Mo	6.6	18.7	4	10.6
2-Dec-08	Tu	8.9	18.1	0	3.6
3-Dec-08	We	10.1	19.3	1	12
4-Dec-08	Th	5.9	21.2	0	1.6
5-Dec-08	Fr	13.6	19.3	12.8	1.8
6-Dec-08	Sa	12.7	19.6	0.6	8.6
7-Dec-08	Su	10.2	16.8	0	2.3
8-Dec-08	Mo	11.1	21	0	9.4
9-Dec-08	Tu	6.9	16.5	0.4	3.9
10-Dec-08	We	7.5	19.9	4.2	14
11-Dec-08	Th	6.2	25.8	0	10.8
12-Dec-08	Fr	13.6	15.4	0.8	0
13-Dec-08	Sa	11.4	14.9	78.8	0
14-Dec-08	Su	11	15.9	2	1.9
15-Dec-08	Mo	10.6	19.9	0	8.6
16-Dec-08	Tu	11.4	19.3	0.4	2.8
17-Dec-08	We	12.4	19.7	6	0.1
18-Dec-08	Th	10.4	19.1	0	6.1
19-Dec-08	Fr	8.9	18.5	0.6	12.5
20-Dec-08	Sa	6.2	24.9	0	14
21-Dec-08	Su	11.3	30.2	0	9.3
22-Dec-08	Mo	18.2	20.6	0	2.3
23-Dec-08	Tu	13.7	20.5	0	6.5
24-Dec-08	We	6.6	25.4	0	13.8
25-Dec-08	Th	9.3	24	0	13.2

26-Dec-08	Fr	11.2	25.8	0	11.8
27-Dec-08	Sa	12.9	22.8	0	13.4
28-Dec-08	Su	13.3	20.6	0	5.1
29-Dec-08	Mo	10.7	19.1	0.8	9.3
30-Dec-08	Tu	13.2	18.8	6	8.8
31-Dec-08	We	12.2	19.6	0	7.1
1-Jan-09	Th	12.6	17	0.8	6.5
2-Jan-09	Fr	7.3	18.8	0	11.7
3-Jan-09	Sa	4	22.6	0	11.9
4-Jan-09	Su	6.2	25.3	0	13.8
5-Jan-09	Mo	6.2	23.1	0	13.6
6-Jan-09	Tu	12.7	24.7	0	8.5
7-Jan-09	We	13.7	21.2	1.4	8
8-Jan-09	Th	10.1	19.3	0	11.7
9-Jan-09	Fr	6.4	21.6	0	9.9
10-Jan-09	Sa	9	22.5	0	13.8
11-Jan-09	Su	7.7	22.6	0	11.2
12-Jan-09	Mo	14	27.2	0	11.6
13-Jan-09	Tu	13.6	39.3	0	13
14-Jan-09	We	15.2	23	0	5.8
15-Jan-09	Th	11.8	22.1	0	12.1
16-Jan-09	Fr	13.3	19.9	0	12
17-Jan-09	Sa	6.8	23.1	0	13.4
18-Jan-09	Su	4.9	29	0	13.8
19-Jan-09	Mo	9.7	33.7	0	13.4
20-Jan-09	Tu	12.3	30.2	0	12
21-Jan-09	We	9	25.7	0	10.8
22-Jan-09	Th	14.9	22.7	0	5.2
23-Jan-09	Fr	7.8	24.5	0	7.4
24-Jan-09	Sa	12.9	20.6	3.2	11.6
25-Jan-09	Su	5.7	24.6	0	13.3
26-Jan-09	Mo	7.8	27.6	0	13.4
27-Jan-09	Tu	10.6	39.5	0	13.3
28-Jan-09	We	21.1	43.6	0	13.2
29-Jan-09	Th	21.2	43.6	0	11.4
30-Jan-09	Fr	20.5	36.8	0	12.6
31-Jan-09	Sa	17.5	32.4	0	9.7

Min Max temp and Rainfall (Sunlight hours NA) for **Bairnsdale Airport** – approx 12kms from production sites

Date	Temps		Rain
	Min	Max	
	°C	°C	mm
1-Jun-08	5.9	14.9	3.4
2-Jun-08	6.6	15.9	0.2
3-Jun-08	5.6	14.3	0
4-Jun-08	4.9	14.2	0.6
5-Jun-08	0.7	15.5	0
6-Jun-08	0.8	19.4	0
7-Jun-08	6.4	17.4	0.6
8-Jun-08	1.8	15.2	0
9-Jun-08	2.4	13.7	0
10-Jun-08	2	13.5	0
11-Jun-08	5.4	12.8	0.8
12-Jun-08	-0.8	12.3	0.6
13-Jun-08	-0.9	14.3	0
14-Jun-08	6.7	18.2	0
15-Jun-08	-0.4	13	0
16-Jun-08	4.3	14.9	0
17-Jun-08	2.4	15.5	0
18-Jun-08	4.8	15.6	0
19-Jun-08	-0.3	15.9	0
20-Jun-08	8	17.1	1.2
21-Jun-08	5.9	11.9	5.2
22-Jun-08	3	12.7	2.4
23-Jun-08	2.5	13.9	0
24-Jun-08	-1.2	12.9	0.2
25-Jun-08	-2.2	14.9	0.2
26-Jun-08	1	15.8	0
27-Jun-08	2.3	13.8	0
28-Jun-08	4.8	12.3	13.4
29-Jun-08	5	12.6	11
30-Jun-08	0.2	14.9	0.2
1-Jul-08	4.8	17.3	0
2-Jul-08	7.4	16.7	0.4
3-Jul-08	7.4	15	2.4
4-Jul-08	4.6	16.6	0
5-Jul-08	4.1	16.4	0
6-Jul-08	5.7	13.4	0.6
7-Jul-08	3.7	15	0
8-Jul-08	1.6	14.1	0.2
9-Jul-08	5.6	14.4	0
10-Jul-08	4	13.8	0.6
11-Jul-08	1.4	11.4	0.4
12-Jul-08	3.9	14.7	0

13-Jul-08	2.2	15.9	1.2
14-Jul-08	5	13.5	0
15-Jul-08	8.3	14.8	0
16-Jul-08	9.1	16.4	0.2
17-Jul-08	7	13.9	0.2
18-Jul-08	4.1	13.8	0.2
19-Jul-08	2.8	13.3	0
20-Jul-08	2.2	16.3	0
21-Jul-08	6.9	17.3	0
22-Jul-08	3.7	15.7	0
23-Jul-08	2.6	9	5.8
24-Jul-08	0.7	14.3	11.6
25-Jul-08	5.7	14.7	0
26-Jul-08	0.9	15.7	0
27-Jul-08	1.8	18	0
28-Jul-08	5.6	13.1	0
29-Jul-08	2.4	15.4	0
30-Jul-08	-1	15.7	0
31-Jul-08	1.8	20.3	0.2
1-Aug-08	9	19.6	0
2-Aug-08	4.7	17	1.6
3-Aug-08	4.9	17.1	0.2
4-Aug-08	6.9	13	0
5-Aug-08	1.2	16.1	0
6-Aug-08	0.7	17.3	0
7-Aug-08	1.3	17.2	0
8-Aug-08	3.2	17.7	0
9-Aug-08	5.1	14.1	1.2
10-Aug-08	1.2	12.4	0
11-Aug-08	6.5	16.7	0
12-Aug-08	1	21.6	0
13-Aug-08	8.3	25.1	0
14-Aug-08	8.9	27.5	0
15-Aug-08	16.5	23.6	0
16-Aug-08	5.5	22.6	0
17-Aug-08	6.2	13.5	1.8
18-Aug-08	4.9	15.8	0.6
19-Aug-08	-0.2	21.9	0
20-Aug-08	9.7	28	0
21-Aug-08	8.5	22.2	1.2
22-Aug-08	2.7	20.4	0
23-Aug-08	7.3	29	0
24-Aug-08	5.9	17.8	12
25-Aug-08	2.8	18.5	0
26-Aug-08	3.5	21.4	0
27-Aug-08	8.8	26.7	0
28-Aug-08	9.6	21.1	0
29-Aug-08	9.9	20.4	0
30-Aug-08	6.4	14.8	0.6

31-Aug-08	0.8	17.1	0
1-Sep-08	4.7	17	1.6
2-Sep-08	4.9	17.1	0.2
3-Sep-08	6.9	13	0
4-Sep-08	1.2	16.1	0
5-Sep-08	0.7	17.3	0
6-Sep-08	1.3	17.2	0
7-Sep-08	3.2	17.7	0
8-Sep-08	5.1	14.1	1.2
9-Sep-08	1.2	12.4	0
10-Sep-08	6.5	16.7	0
11-Sep-08	1	21.6	0
12-Sep-08	8.3	25.1	0
13-Sep-08	8.9	27.5	0
14-Sep-08	16.5	23.6	0
15-Sep-08	5.5	22.6	0
16-Sep-08	6.2	13.5	1.8
17-Sep-08	4.9	15.8	0.6
18-Sep-08	-0.2	21.9	0
19-Sep-08	9.7	28	0
20-Sep-08	8.5	22.2	1.2
21-Sep-08	2.7	20.4	0
22-Sep-08	7.3	29	0
23-Sep-08	5.9	17.8	12
24-Sep-08	2.8	18.5	0
25-Sep-08	3.5	21.4	0
26-Sep-08	8.8	26.7	0
27-Sep-08	9.6	21.1	0
28-Sep-08	9.9	20.4	0
29-Sep-08	6.4	14.8	0.6
30-Sep-08	0.8	17.1	0
1-Oct-08	1.9	21.2	0
2-Oct-08	10.2	22.8	0
3-Oct-08	5.3	27.2	0
4-Oct-08	9.1	12.5	4
5-Oct-08	4.1	17.9	0.6
6-Oct-08	4.8	13.1	0
7-Oct-08	5.6	17	3
8-Oct-08	8.3	17.9	0
9-Oct-08	4.1	20.3	0
10-Oct-08	2.6	23.5	0
11-Oct-08	4.4	24.3	0
12-Oct-08	7.3	30.7	0
13-Oct-08	16	28.1	0
14-Oct-08	9.9	17.1	0
15-Oct-08	4.8	21.7	0
16-Oct-08	4.7	19.3	0
17-Oct-08	5.1	20.7	0
18-Oct-08	6.3	31.7	0

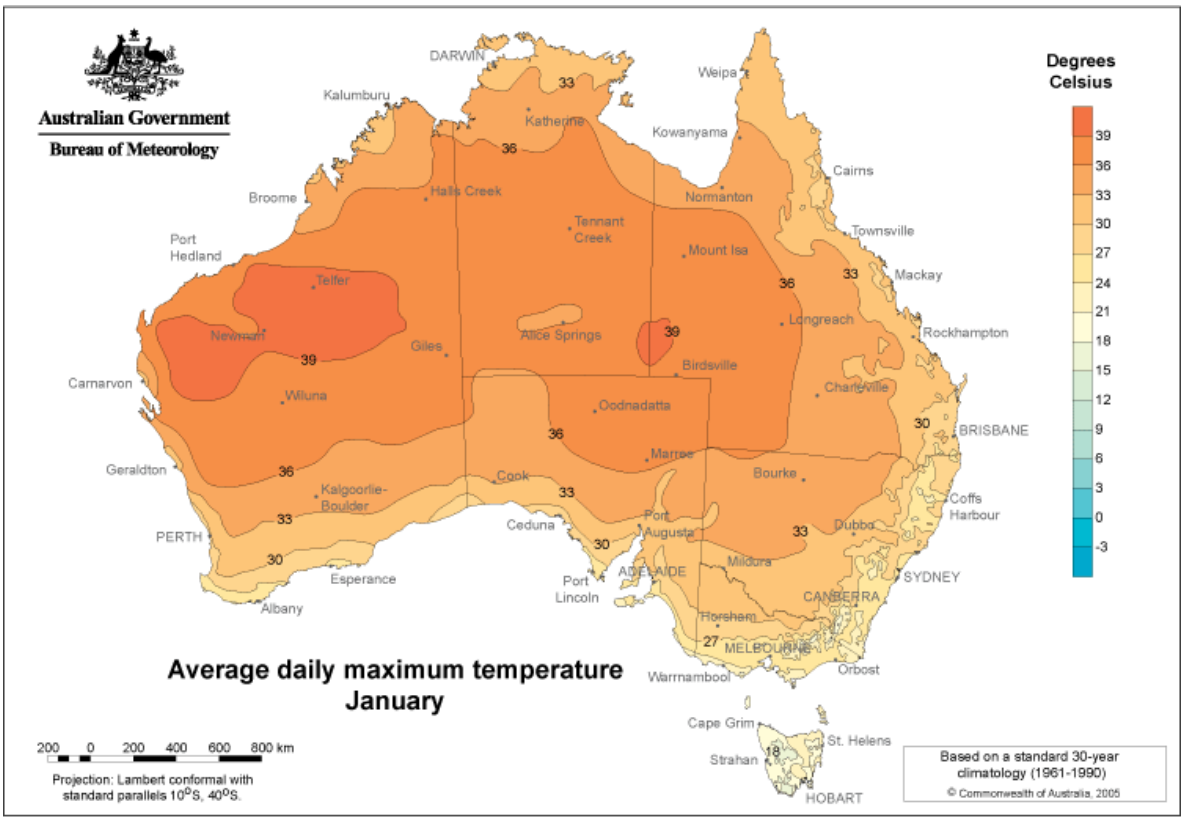
19-Oct-08	14.4	22.8	0
20-Oct-08	7	18.5	0
21-Oct-08	3.8	17.7	0
22-Oct-08	5.8	15.4	1.4
23-Oct-08	5.2	15.7	2.4
24-Oct-08	1.9	19.7	0
25-Oct-08	8.3	28.9	0
26-Oct-08	13.6	33.5	0
27-Oct-08	18.1	26.7	0
28-Oct-08	7	20.5	0
29-Oct-08	10.9	19.6	1.2
30-Oct-08	8.5	26.8	0
31-Oct-08	11	25.1	0
1-Nov-08	11.8	20.5	0
2-Nov-08	5.5	26.4	0
3-Nov-08	13.8	20.3	11.2
4-Nov-08	7.9	15.3	0.4
5-Nov-08	1.6	20.6	1.4
6-Nov-08	7	22.4	0
7-Nov-08	8.7	21.4	0
8-Nov-08	13.3	22.7	4
9-Nov-08	9	25.5	0
10-Nov-08	9.4	21.4	0
11-Nov-08	13.1	24.7	0
12-Nov-08	12	33.1	0
13-Nov-08	11.9	37.3	0
14-Nov-08	16.8	19.1	0
15-Nov-08	11.3	21.7	7.2
16-Nov-08	7.9	18.3	0.6
17-Nov-08	6.9	18.8	0
18-Nov-08	5.3	23.7	0
19-Nov-08	14	20.5	0.4
20-Nov-08	15.5	18.7	6.4
21-Nov-08	6.4	20.2	0.6
22-Nov-08	7.2	14.3	2
23-Nov-08	8.7	14.8	63.2
24-Nov-08	10.1	17	4.6
25-Nov-08	11.3	18.5	0.2
26-Nov-08	6.1	23.2	0
27-Nov-08	11.6	29.6	0
28-Nov-08	14.4	18.5	1.6
29-Nov-08	12.9	15.8	19.4
30-Nov-08	9.2	21.7	14
1-Dec-08	11	20	3.8
2-Dec-08	8.3	21.8	0.2
3-Dec-08	11.9	20.8	0
4-Dec-08	6.4	20.5	0.2
5-Dec-08	13.7	30.9	0.8
6-Dec-08	13.8	22.4	0

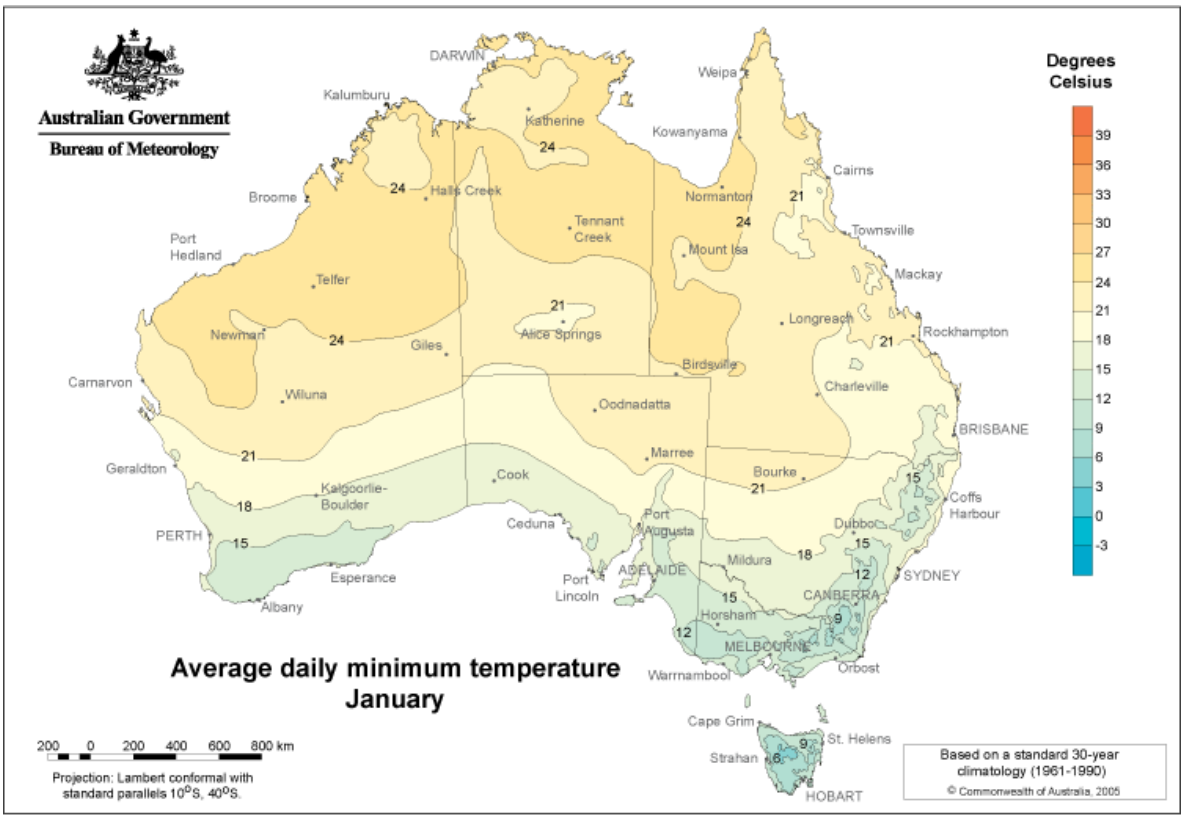
7-Dec-08	12.3	20	0.6
8-Dec-08	11.6	19.9	0.2
9-Dec-08	6.8	23.7	0
10-Dec-08	12	17.5	4
11-Dec-08	6.7	20.5	0.2
12-Dec-08	10.9	23.9	0
13-Dec-08	16	26.3	6.2
14-Dec-08	11.6	15.2	23.6
15-Dec-08	11.3	19.3	4
16-Dec-08	10.2	20.8	0
17-Dec-08	12.7	16.6	1
18-Dec-08	13.4	19.6	6
19-Dec-08	10.5	17.1	8.4
20-Dec-08	6.7	20.1	0.2
21-Dec-08	8.9	24.4	0
22-Dec-08	14.4	30.8	0
23-Dec-08	15.6	22	0
24-Dec-08	10.3	21.5	0
25-Dec-08	11.1	21.2	0
26-Dec-08	10.2	27.3	0
27-Dec-08	14.2	30.2	0
28-Dec-08	13.2	26	1.4
29-Dec-08	14	22.1	0
30-Dec-08	13.1	23.3	0
31-Dec-08	11.6	22.2	0
1-Jan-09	10	24.4	0
2-Jan-09	9.1	19.9	0
3-Jan-09	4.2	18.8	0
4-Jan-09	7.6	22.6	0
5-Jan-09	9.5	27.8	0
6-Jan-09	11.8	27	0
7-Jan-09	15.7	19.3	0
8-Jan-09	11.5	20.2	1
9-Jan-09	5.9	20.2	0
10-Jan-09	10.2	25.6	0
11-Jan-09	10.6	21.8	0
12-Jan-09	10.9	22.3	0.2
13-Jan-09	9.1	32.6	0
14-Jan-09	15.2	38.8	0
15-Jan-09	13.8	25.1	0
16-Jan-09	11.2	21.8	0.2
17-Jan-09	10.8	20.7	0
18-Jan-09	5.4	23.9	0
19-Jan-09	8.2	28.1	0
20-Jan-09	12.7	40.2	0
21-Jan-09	12.7	30.1	0
22-Jan-09	15	33.7	0
23-Jan-09	15.9	23.1	7.4
24-Jan-09	14.6	25	0.2

25-Jan-09	7.5	23.1	0
26-Jan-09	11.7	23.6	0
27-Jan-09	11.9	29.4	0
28-Jan-09	13.4	39.5	0
29-Jan-09	19.5	43.9	0
30-Jan-09	19.9	43.7	0
31-Jan-09	19.7	34	0

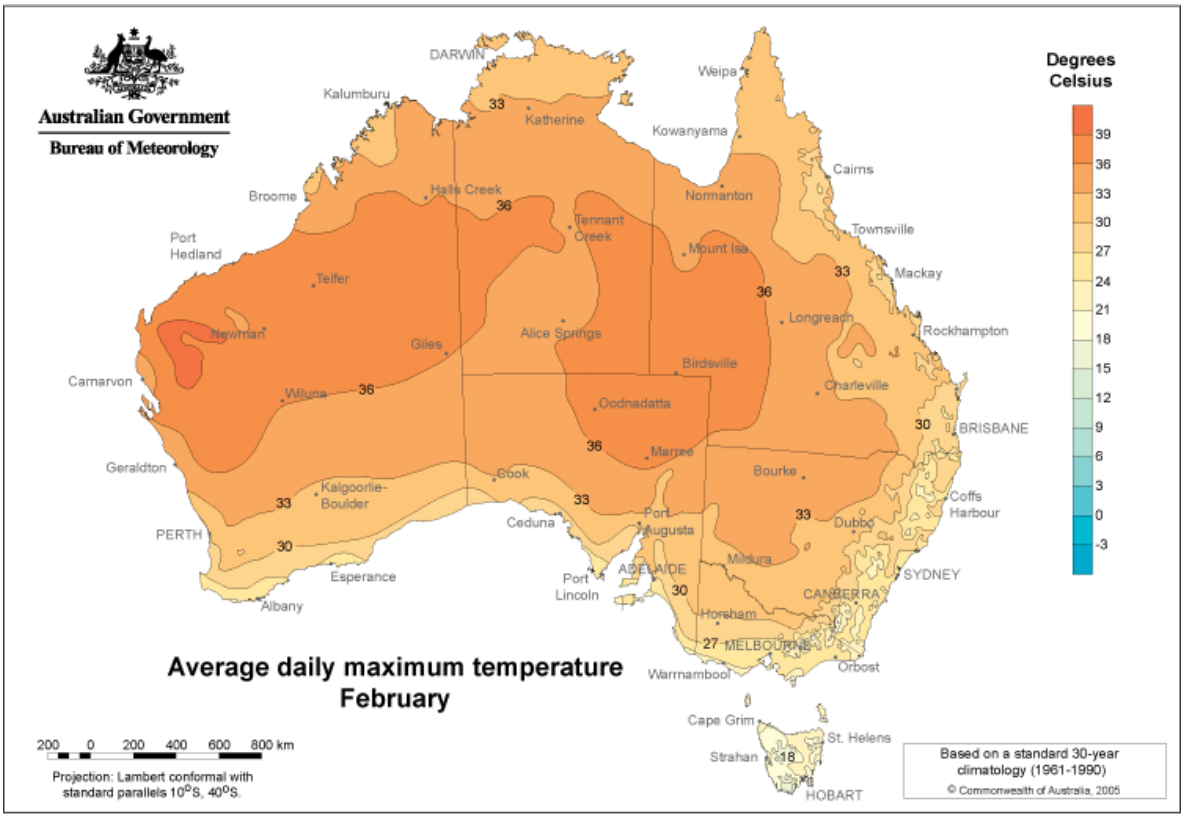
Appendix 4 – Daily Maximum and Minimum Temperature Maps – by month

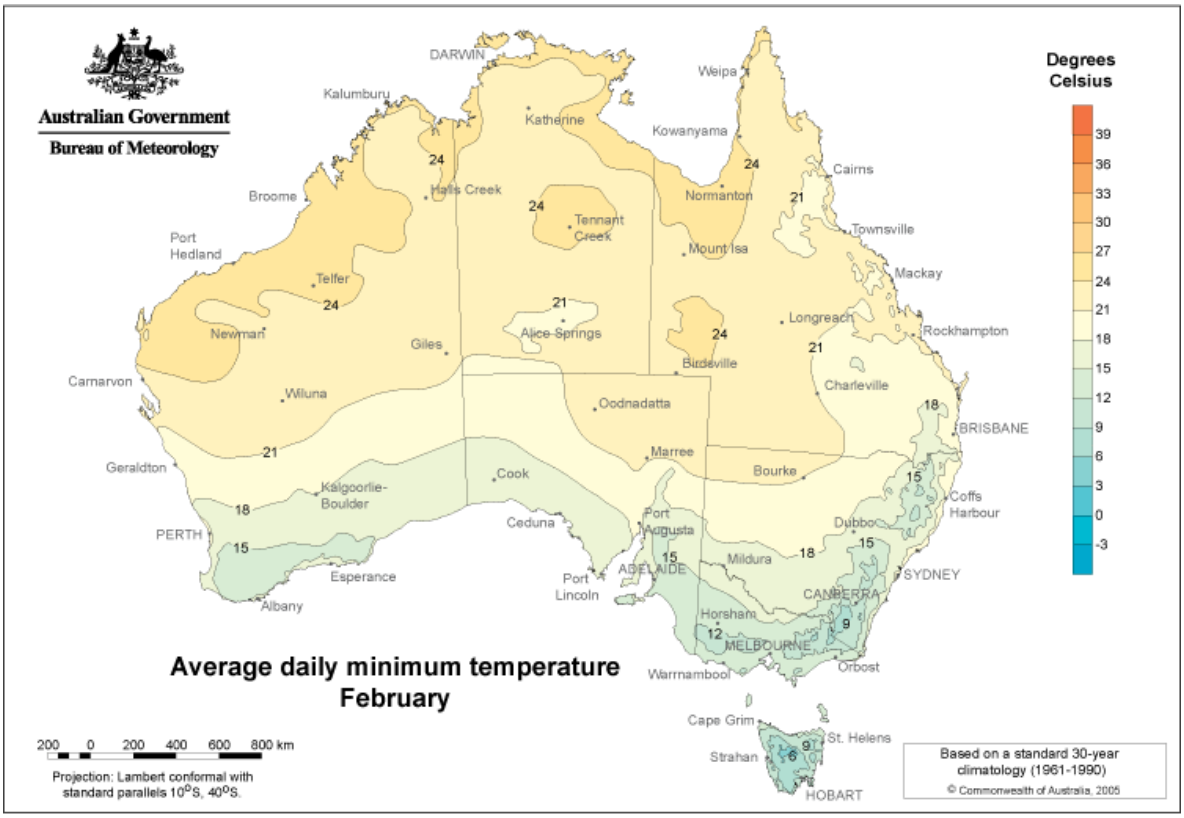
January Average daily maximum and minimum temperature



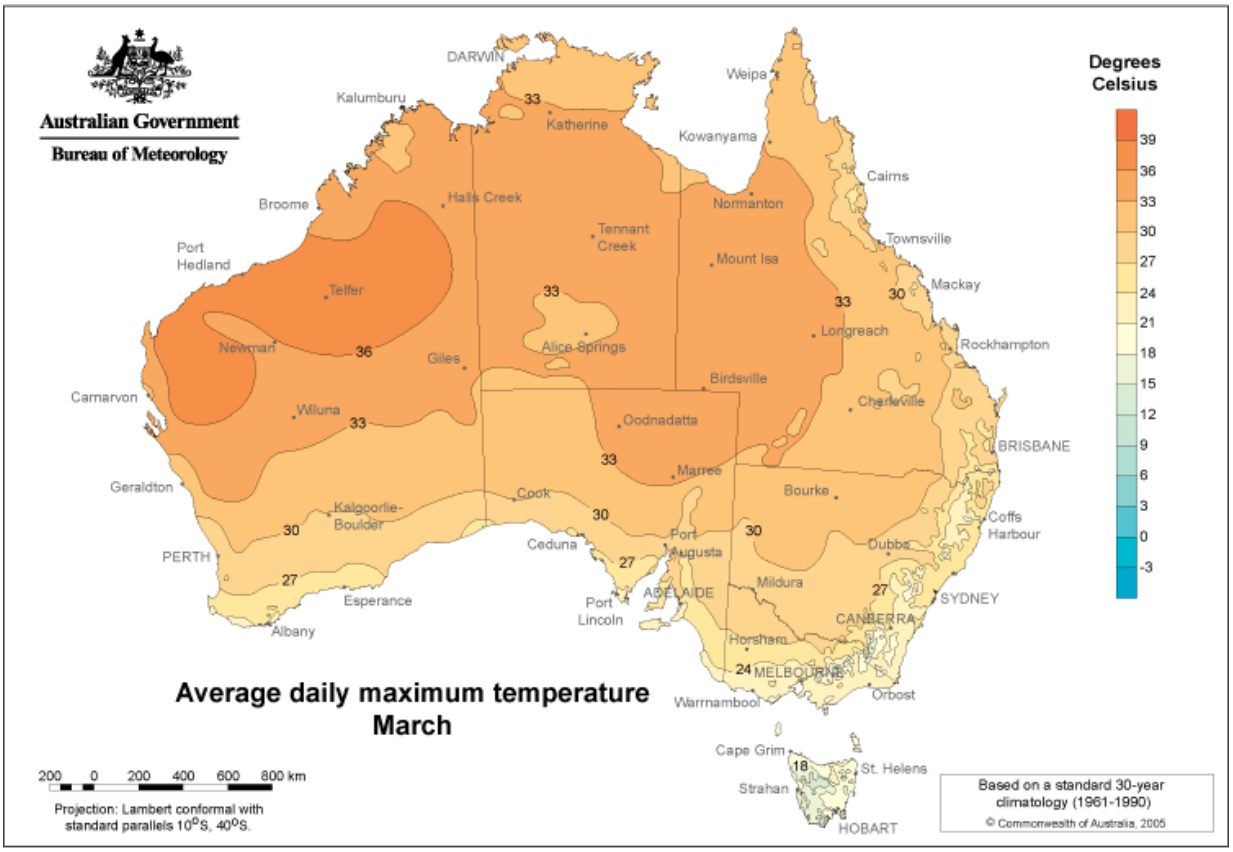


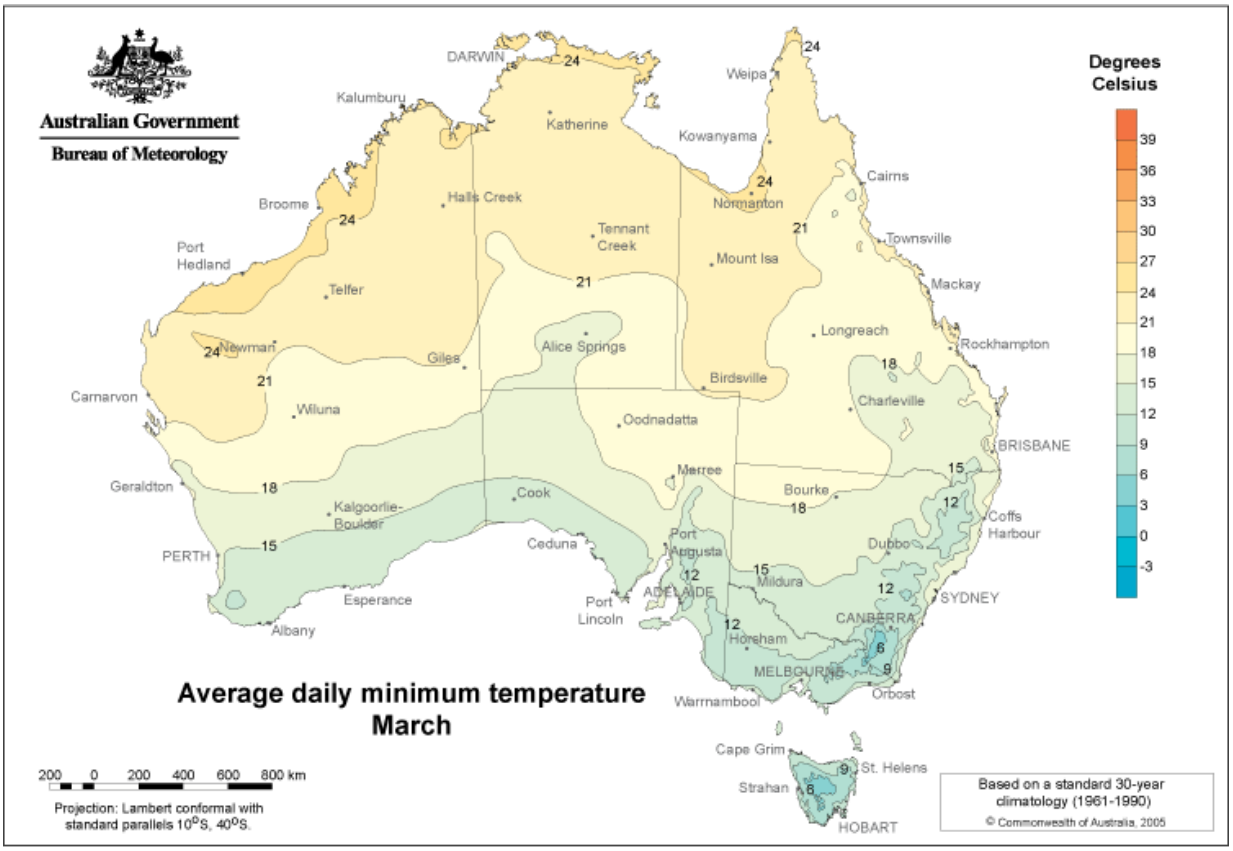
February Average daily maximum and minimum temperature



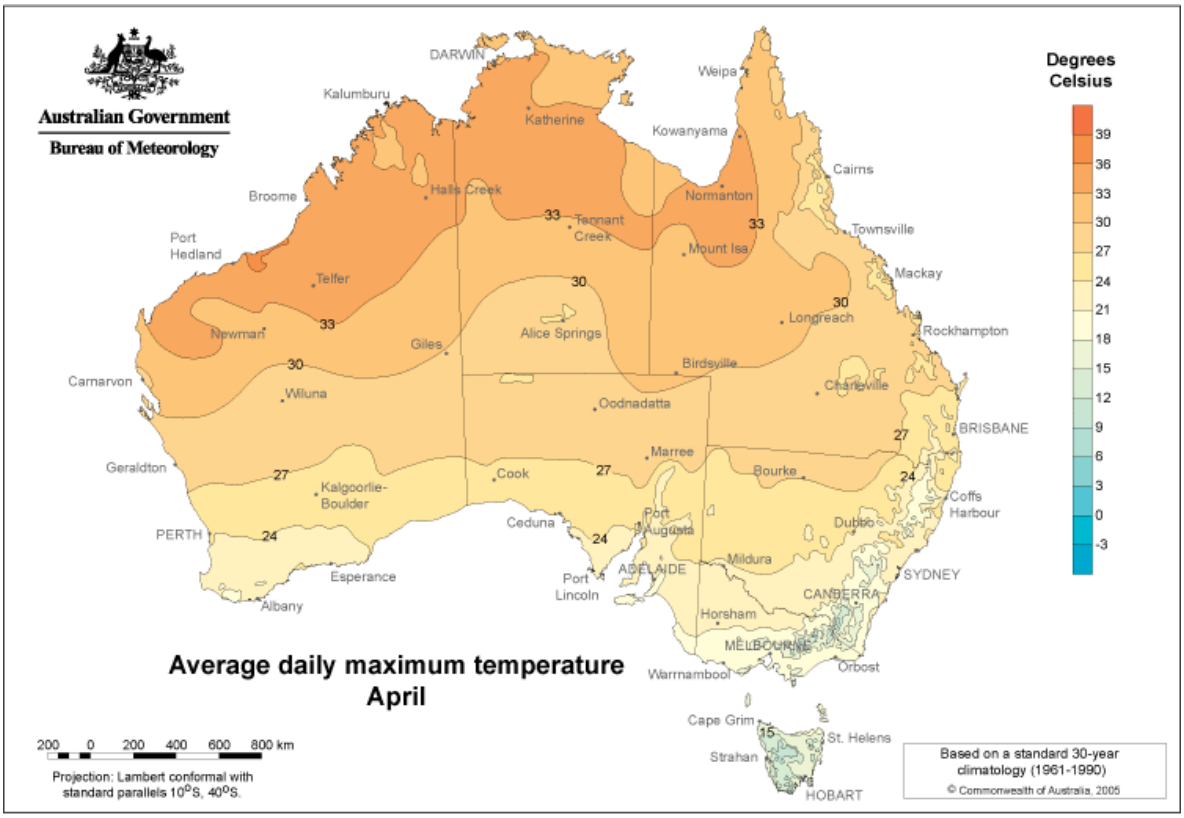


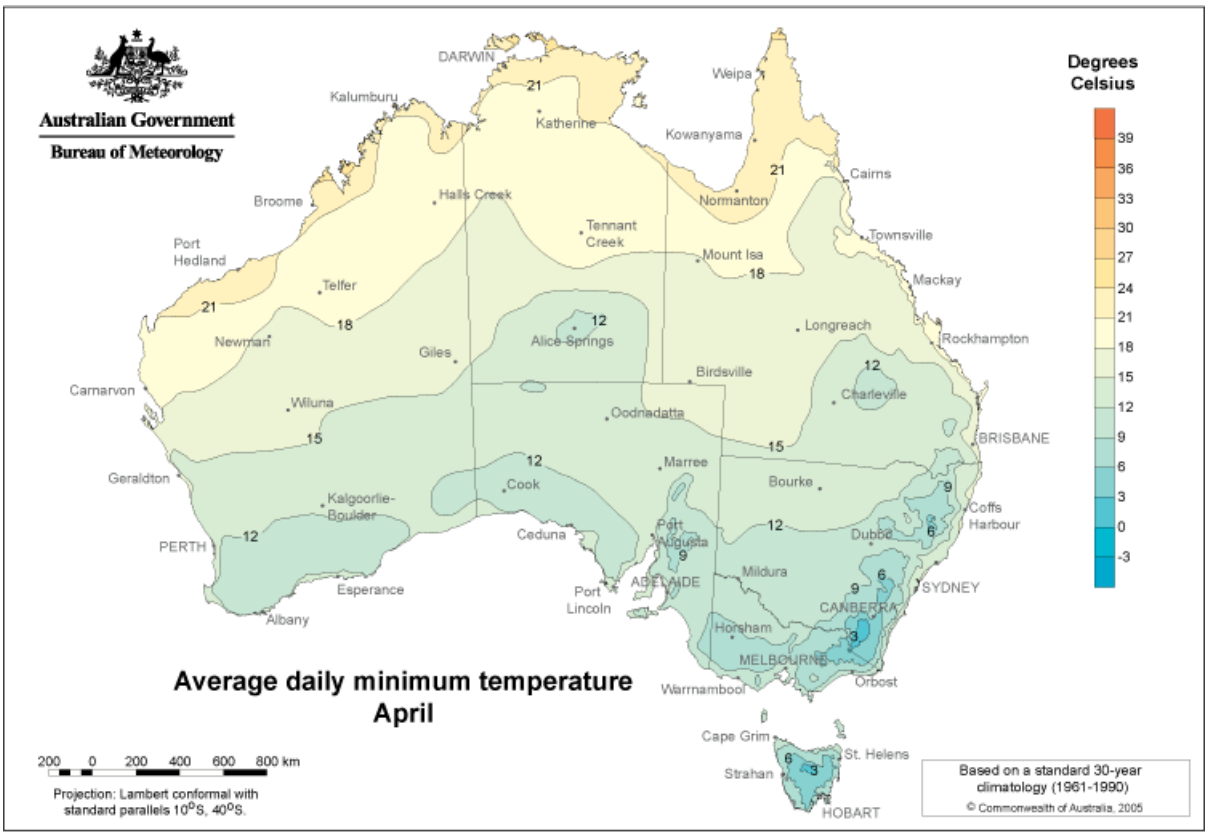
March Average daily maximum and minimum temperature



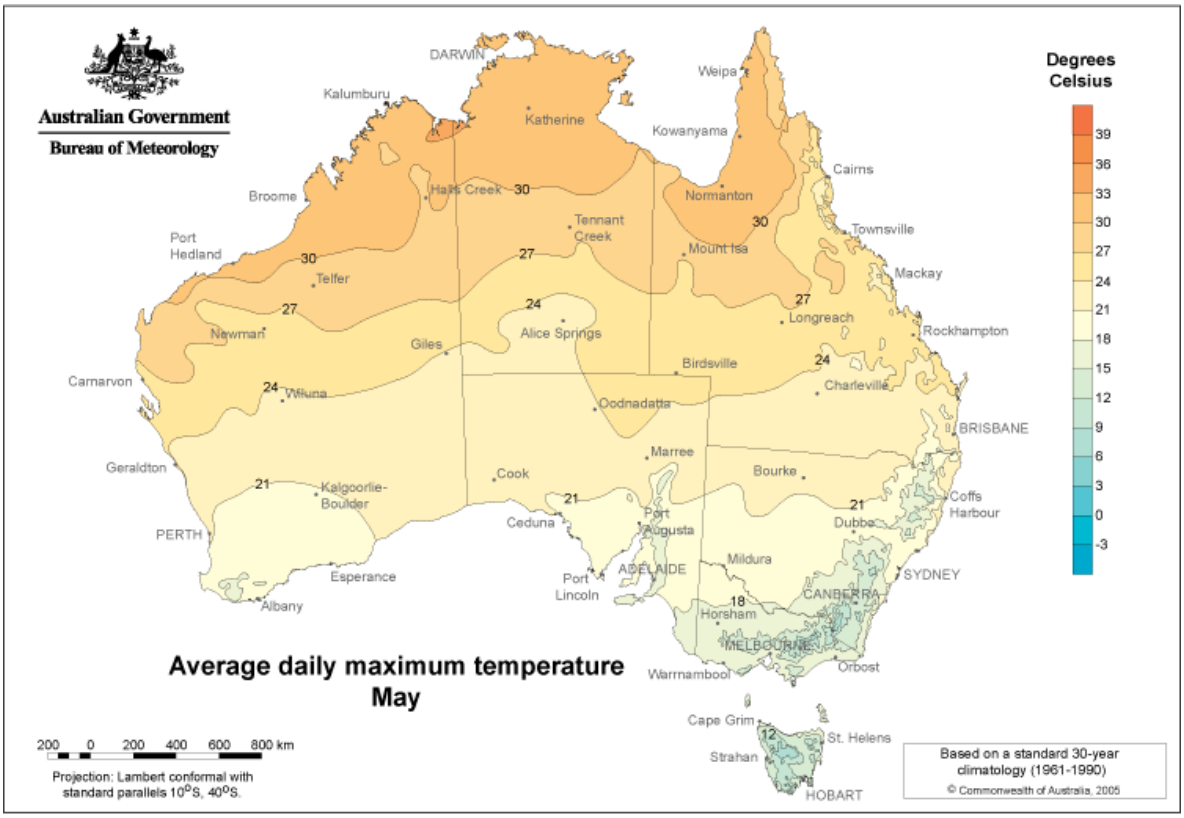


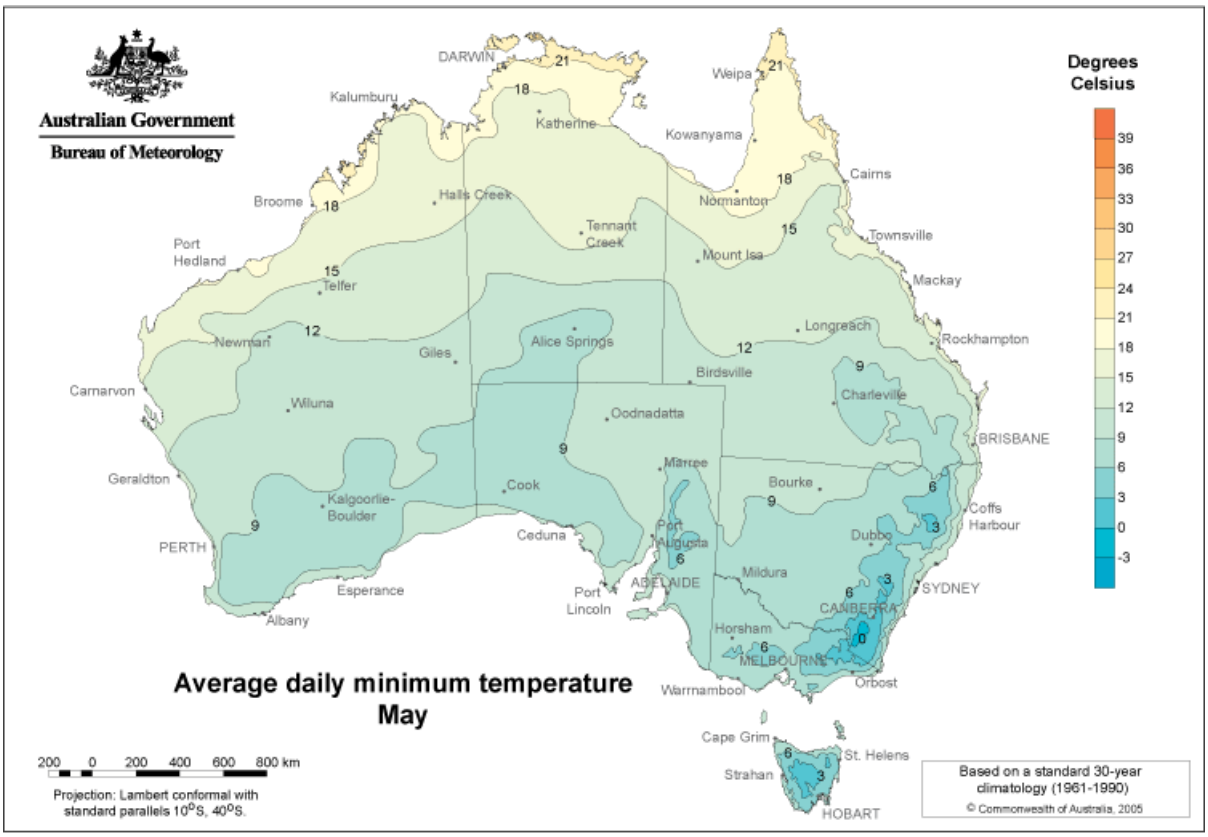
April Average daily maximum and minimum temperature



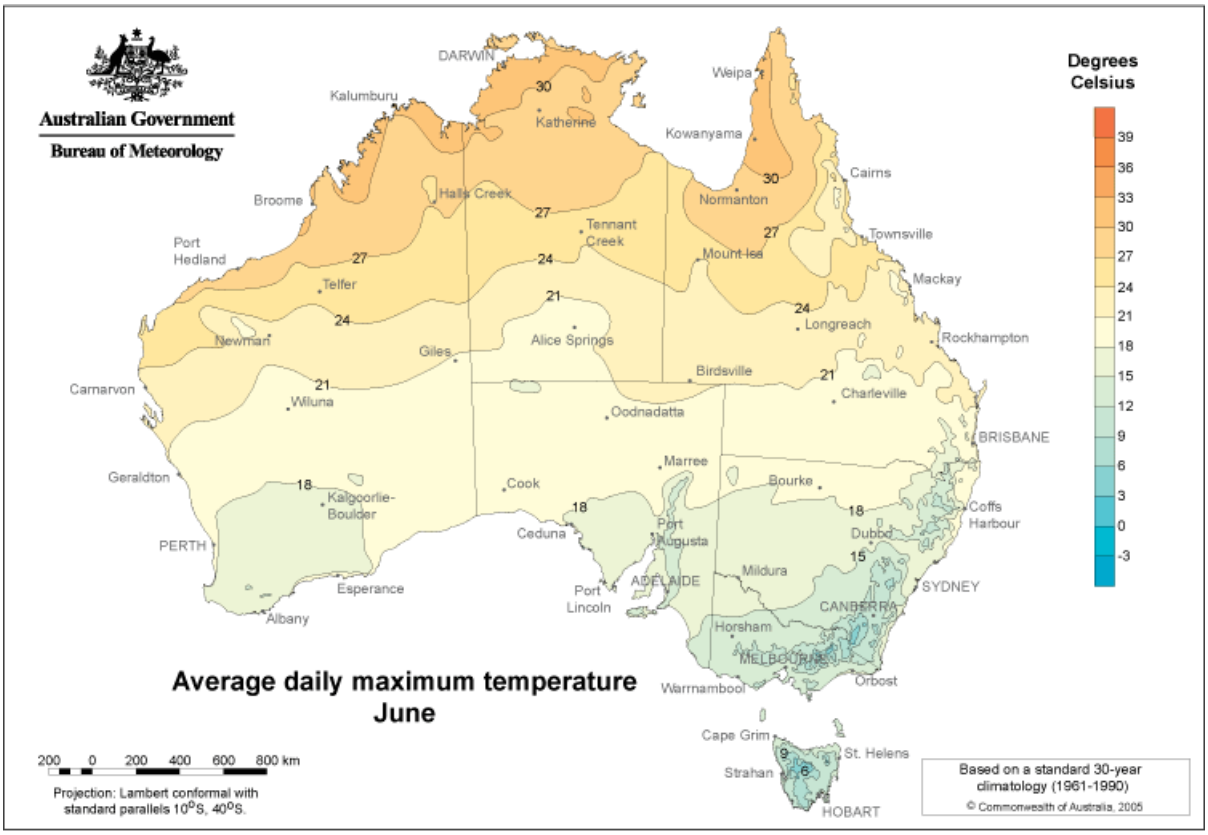


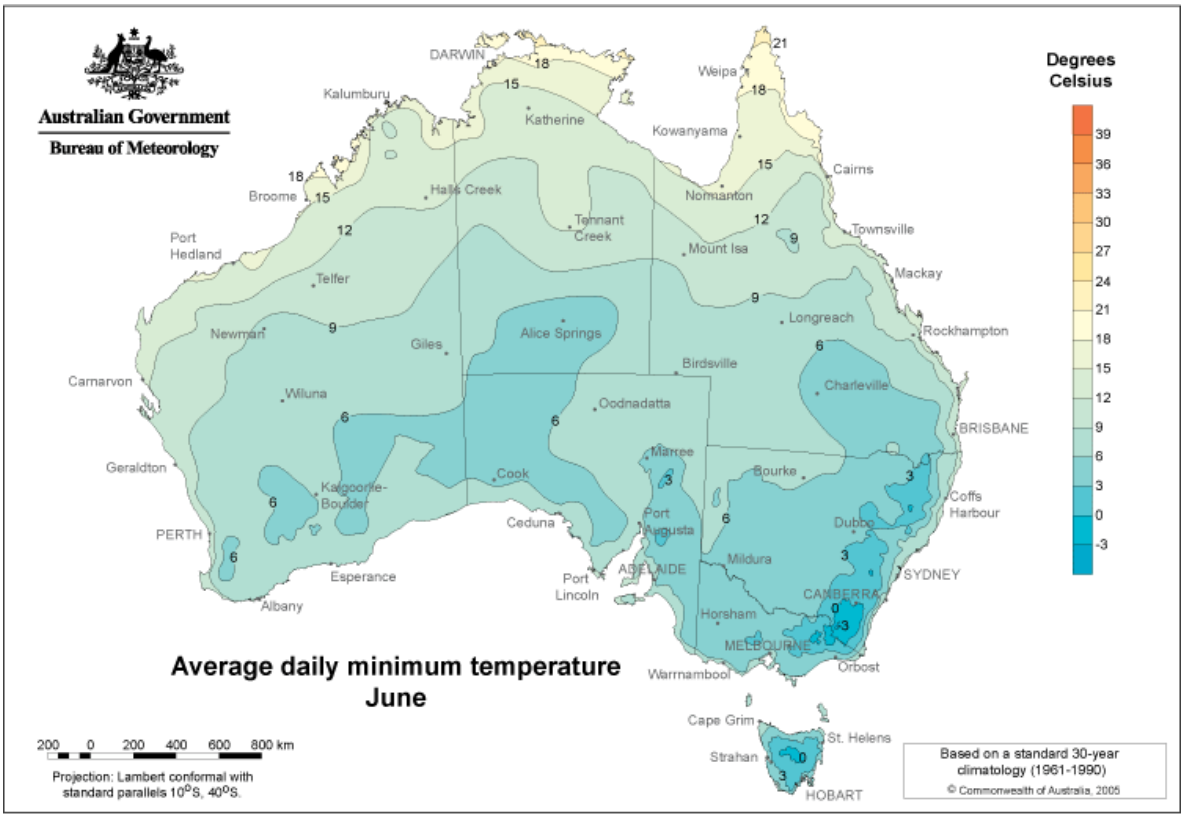
May Average daily maximum and minimum temperature



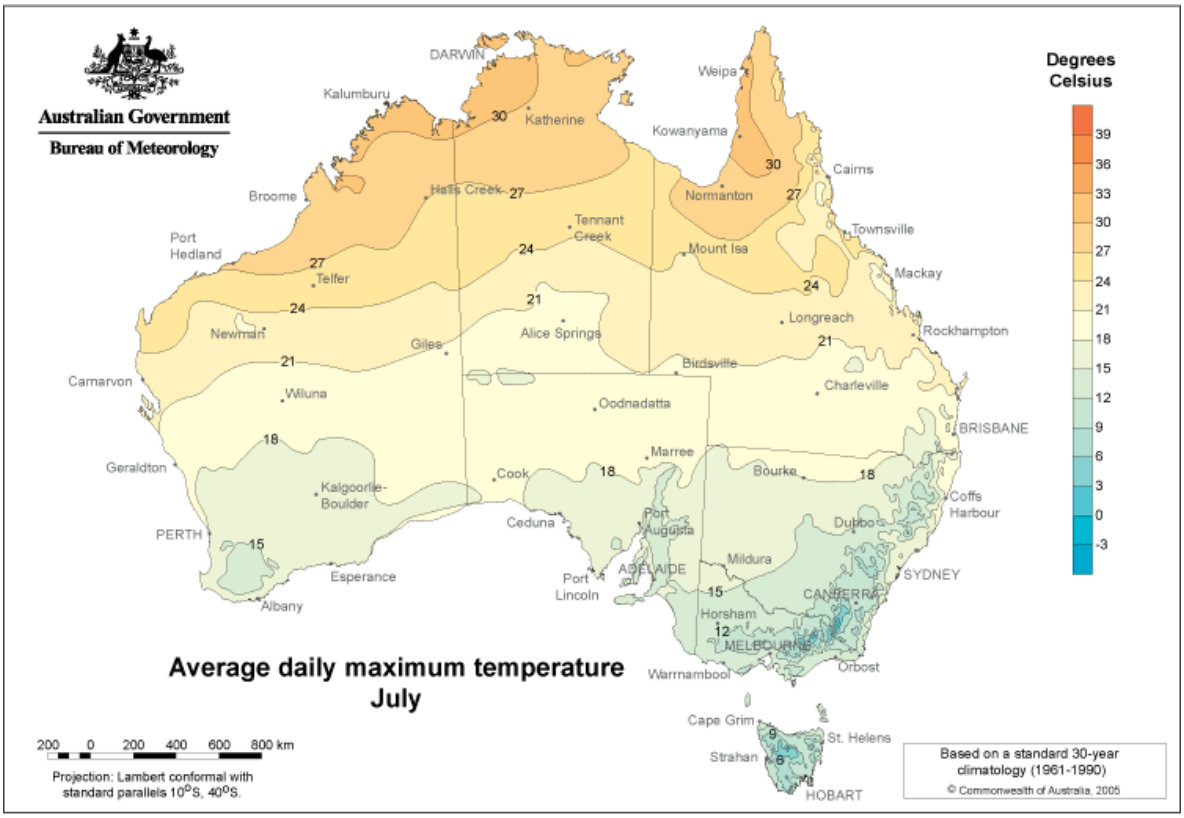


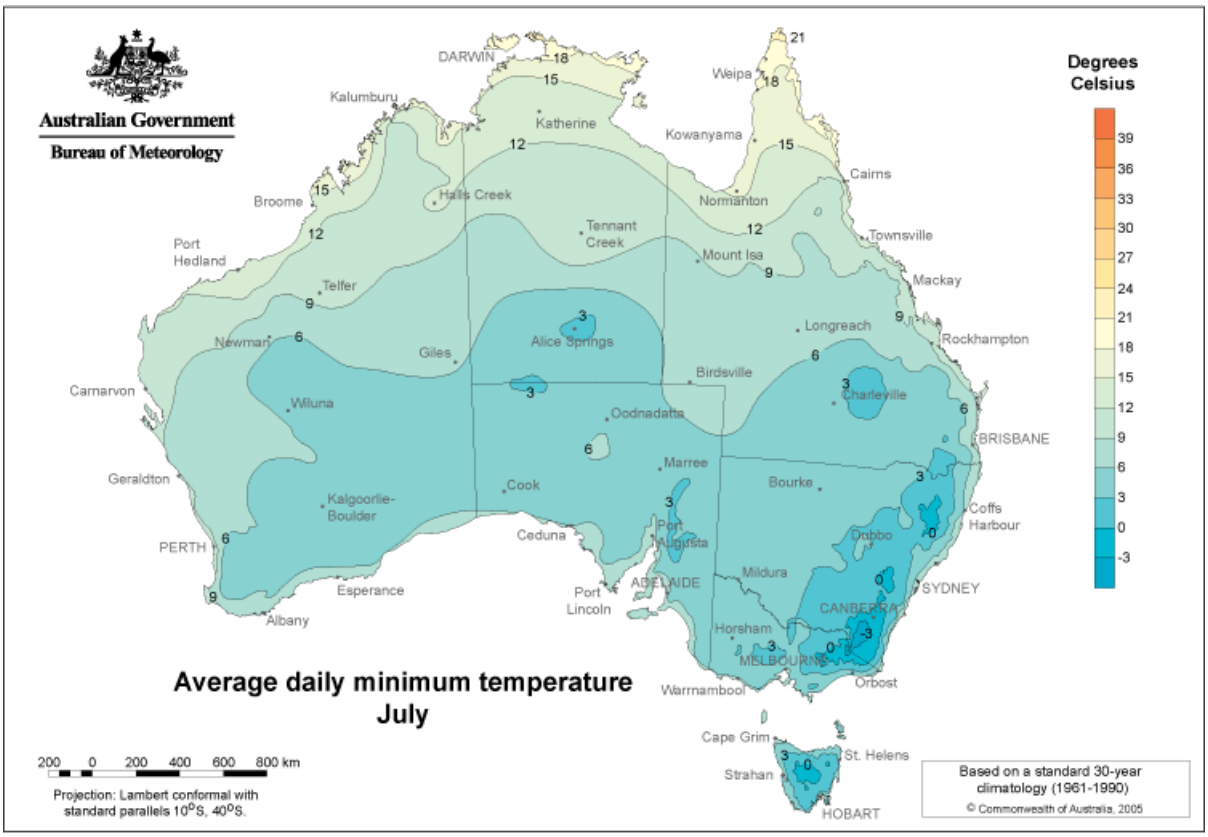
June Average daily maximum and minimum temperature



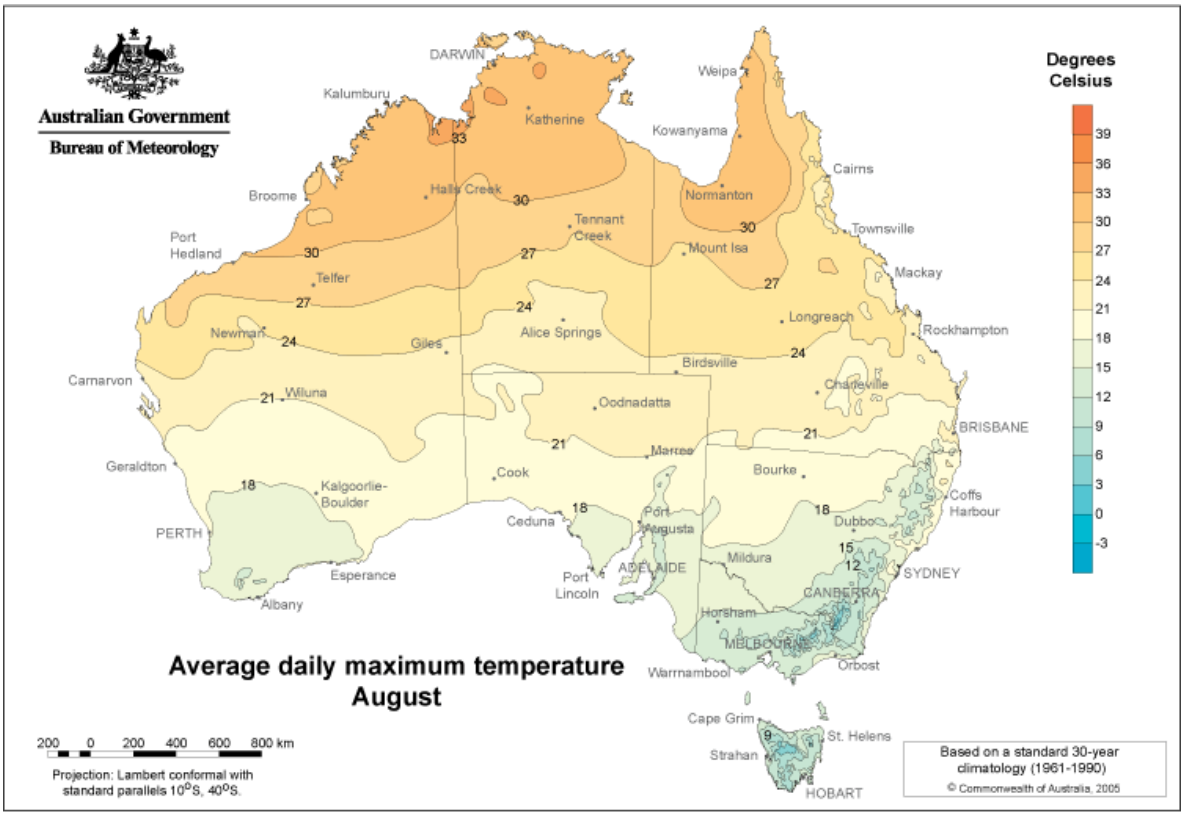


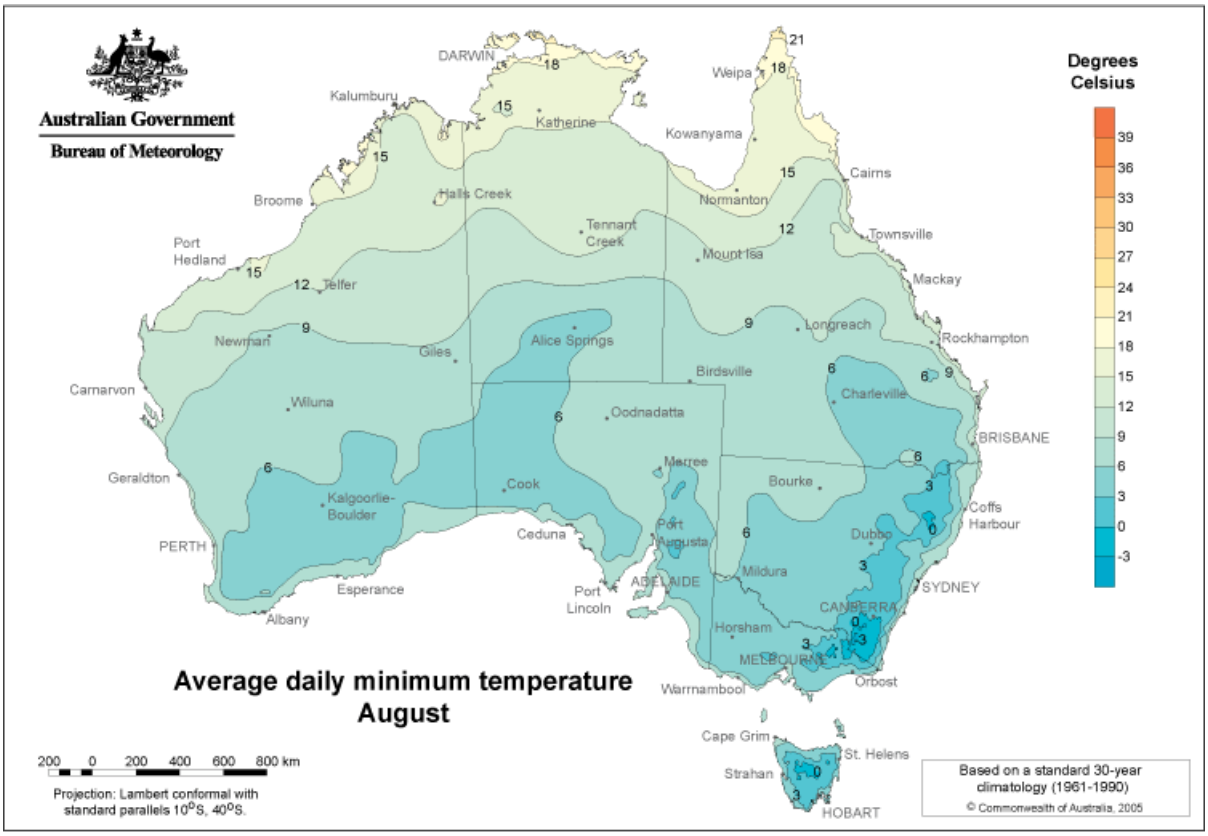
July Average daily maximum and minimum temperature



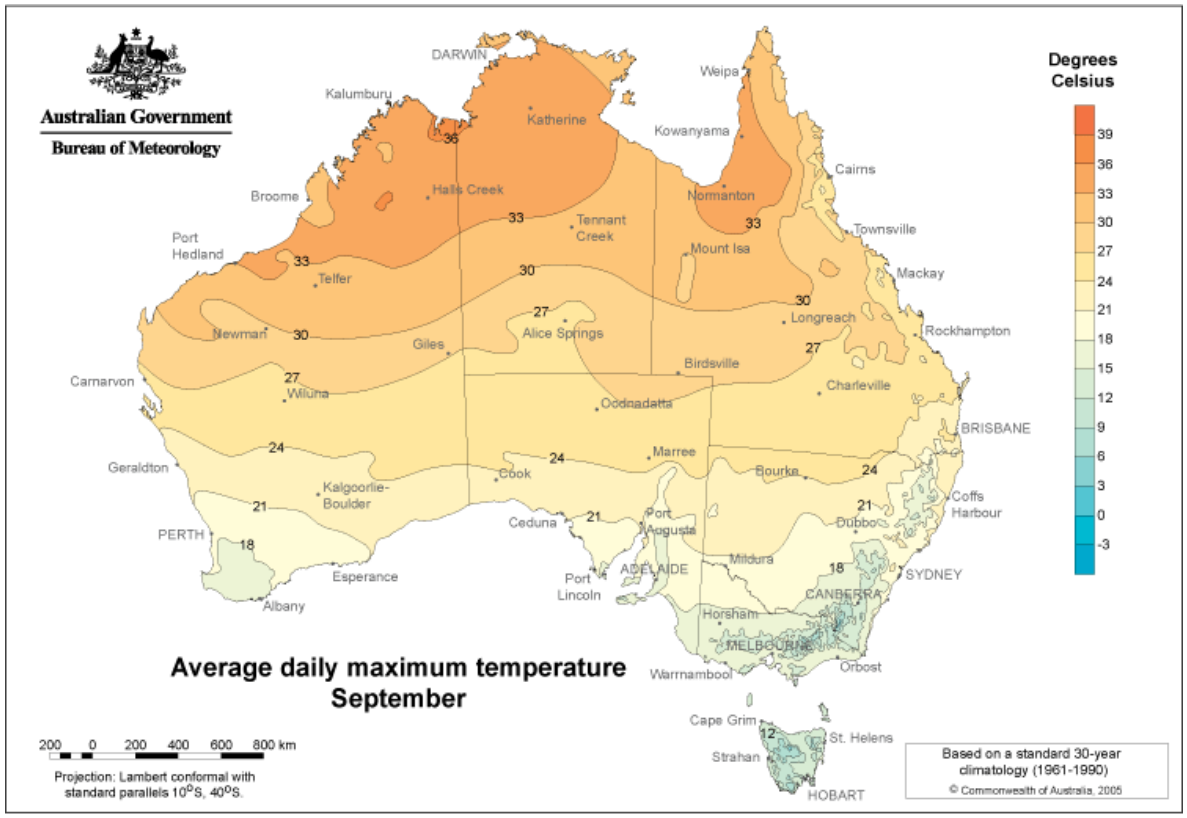


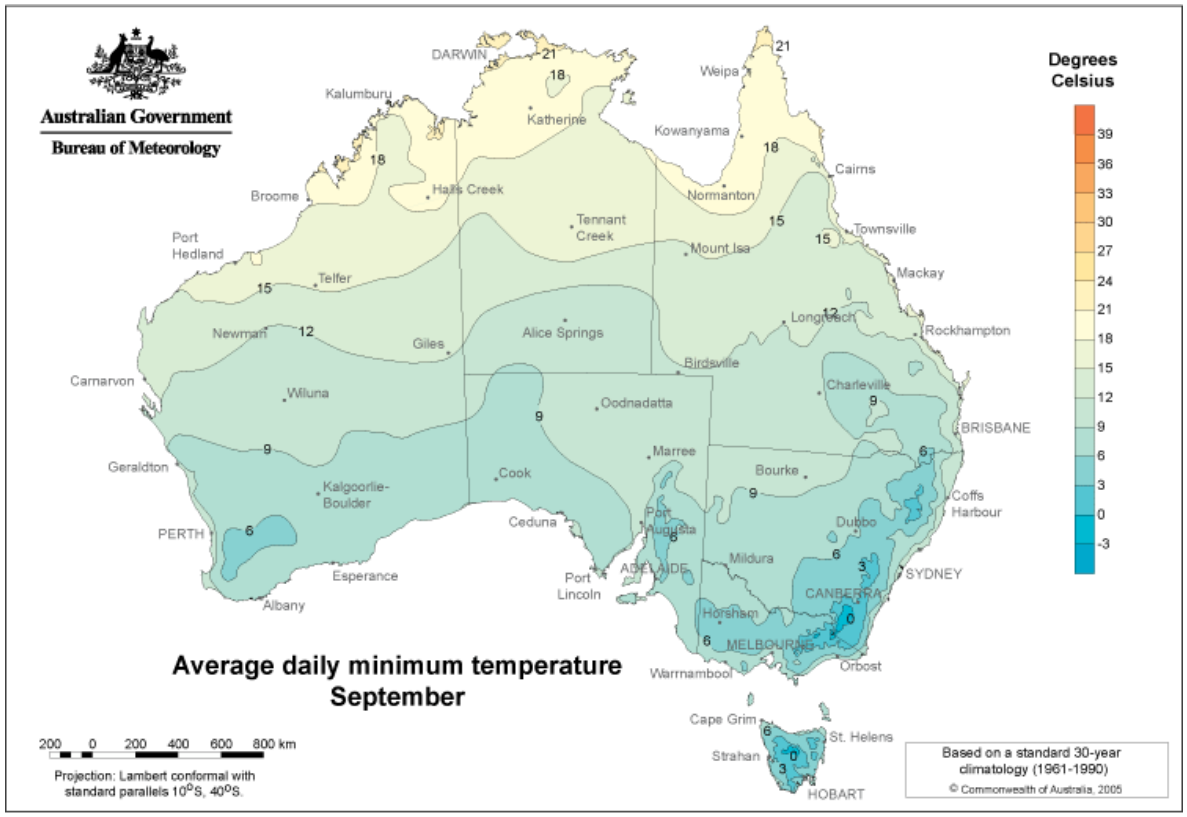
August Average daily maximum and minimum temperature)



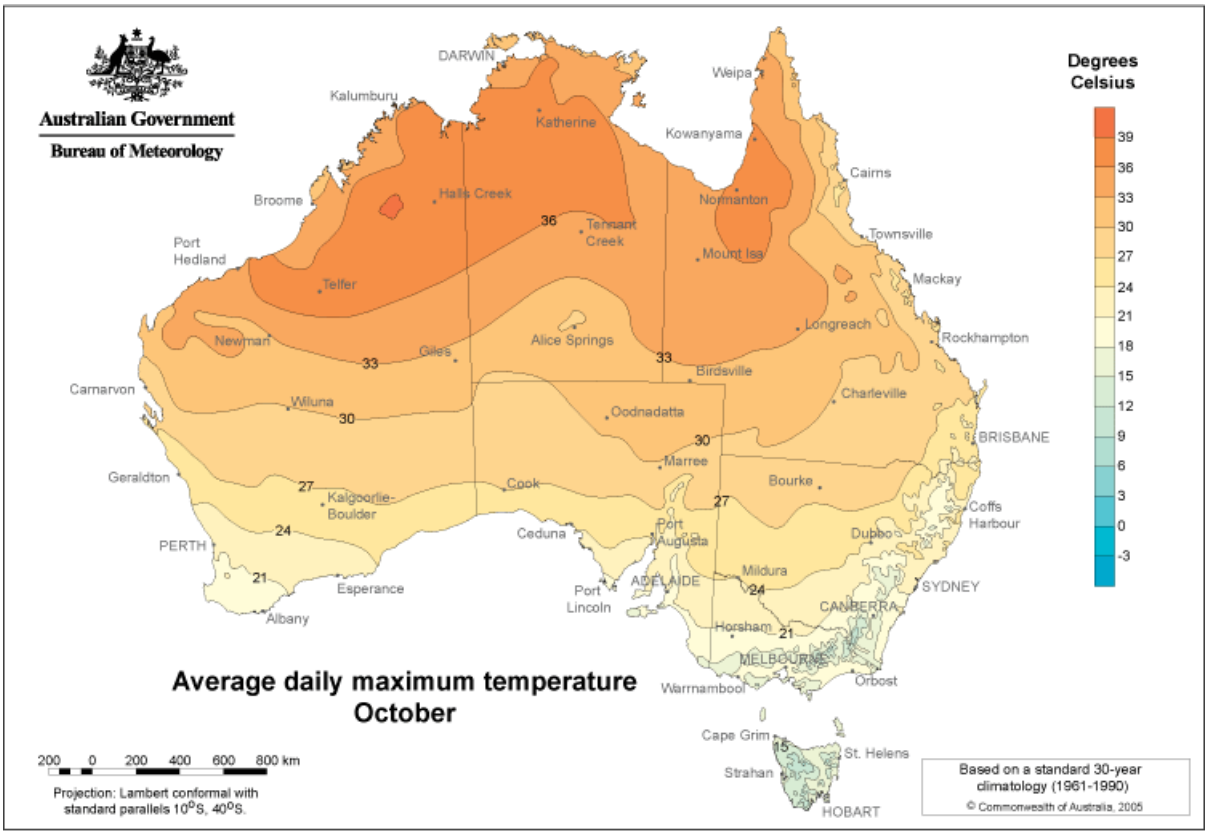


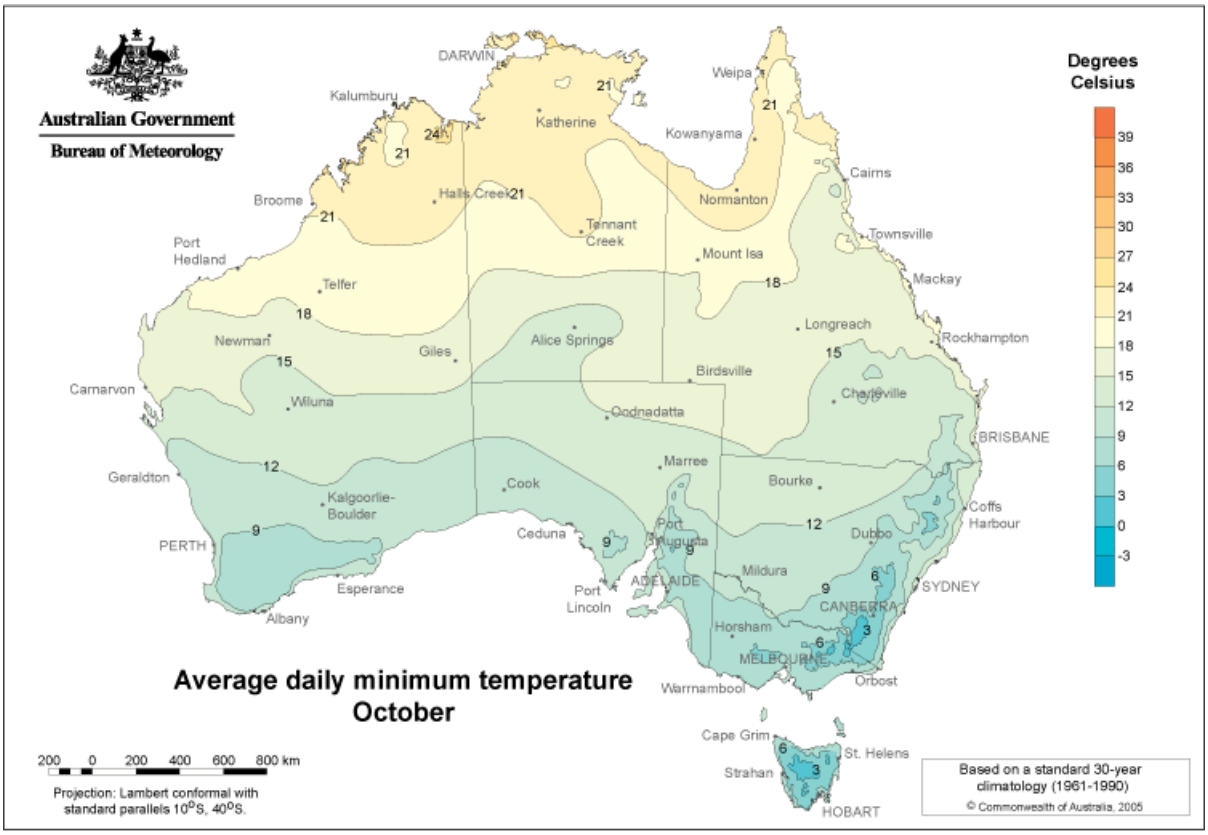
September Average daily maximum and minimum temperature)



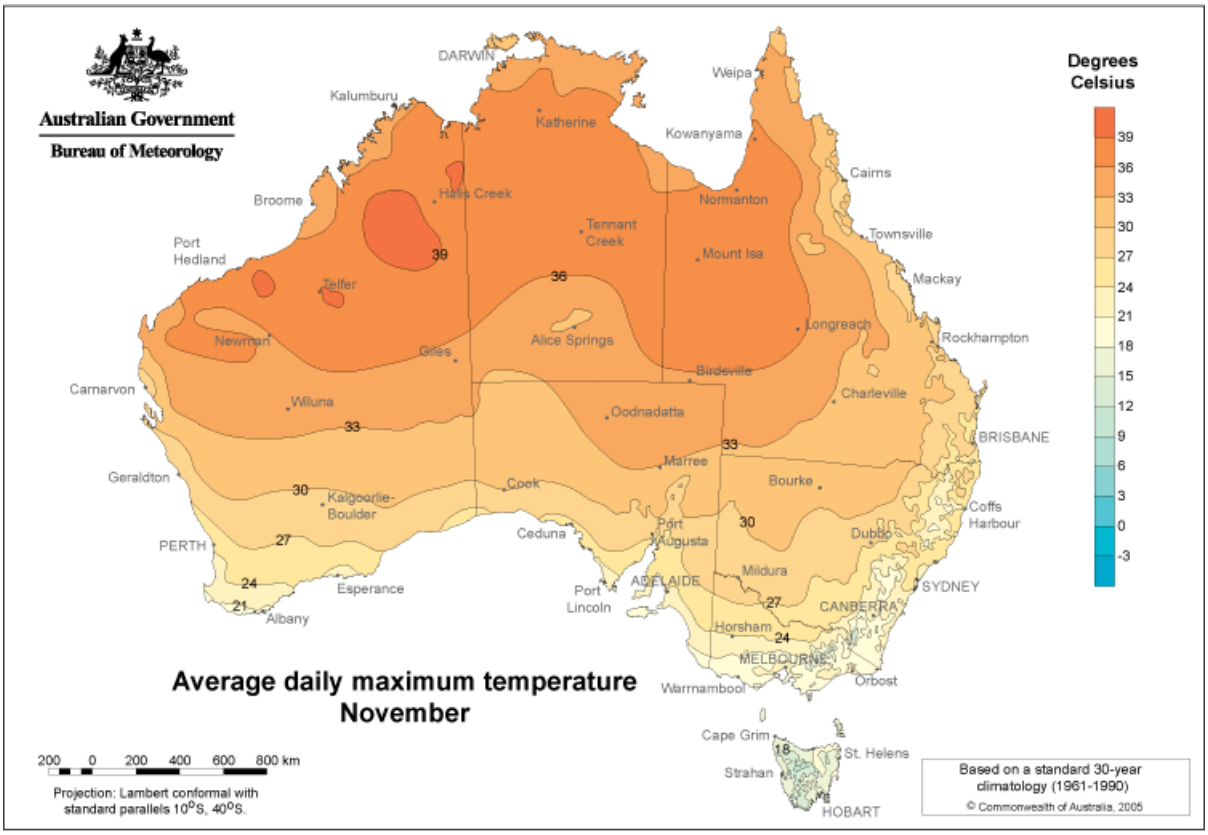


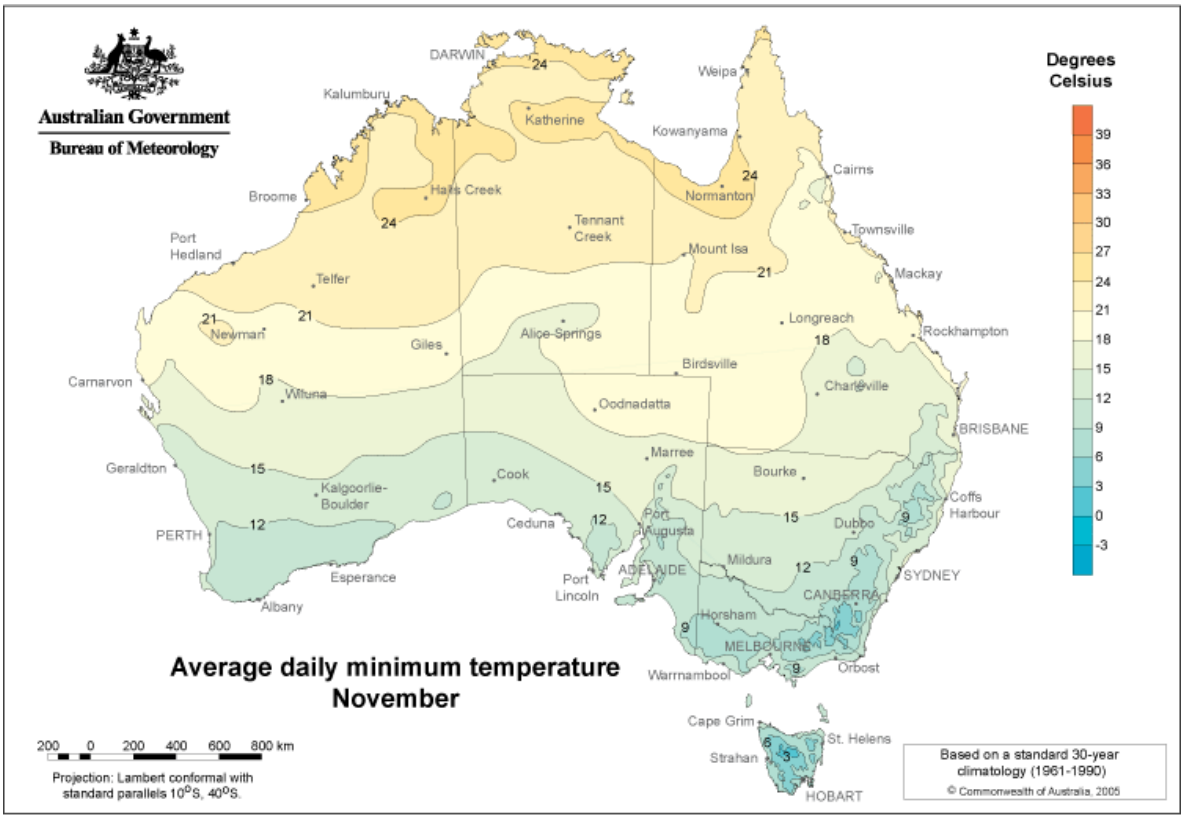
October Average daily maximum and minimum temperature



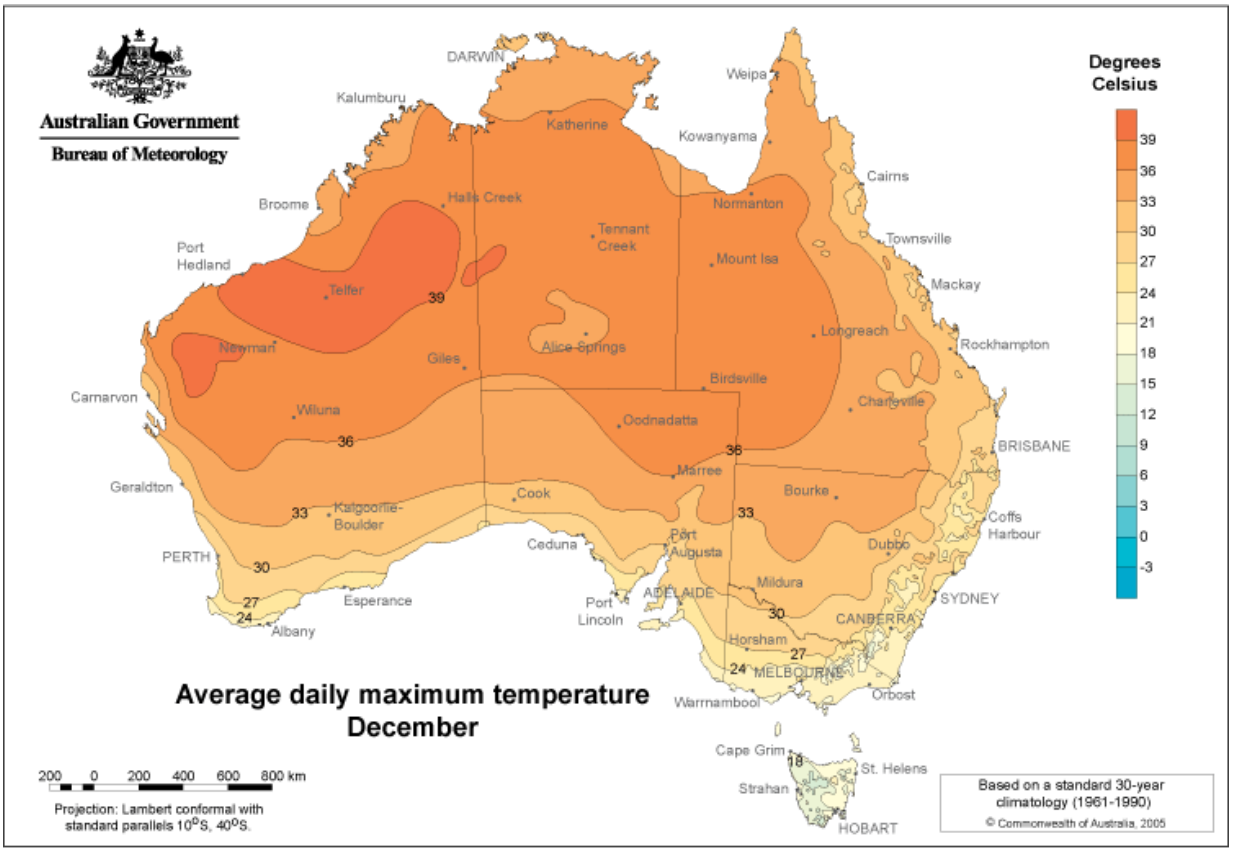


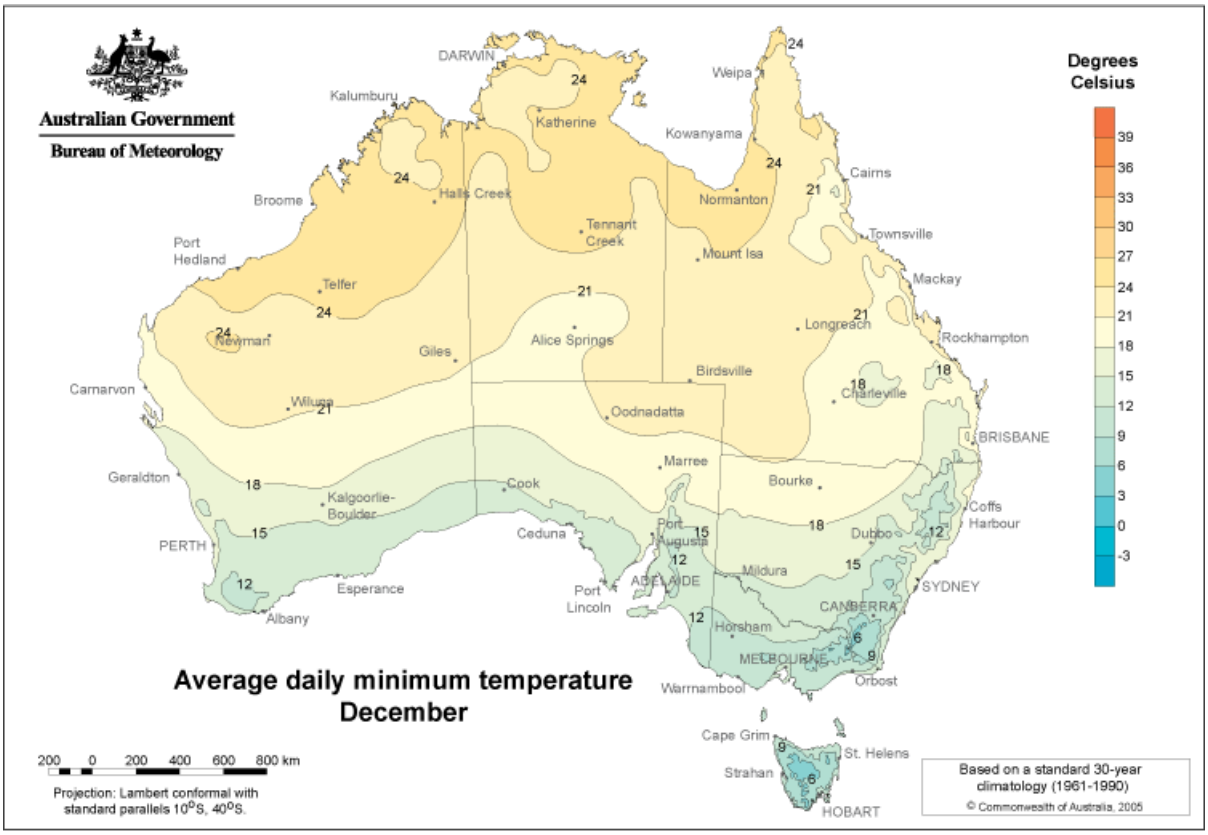
November Average daily maximum and minimum temperature





December Average daily maximum and minimum temperature





Appendix 5 – Planting, Growing and Harvest Data

									PLAN									PLANTING INFO			
Con / Organic	Month	Planned Harvest Week	Product	Variety	Variety split	Quantity	Planting Quantity (kg)	Expected Yield per m2 (kg)	Expected Harvest Week	Block ID	Actual Planting Date	Expected Days to Harvest	Expected Harvest Date	Actual Bed Length m	Days to Germ. (Spinach only)	Days to harvest	Actual Yield / m2 Spinach only	Average head weight	Actual Harvest Date	Harvest Days Variance	Yield Variance
Con	Nov	18	Cos	Avidius	70%	5592	5592	575	26/10/08	1 - 11-6e1/2&5,4,31/2w	**12/08/08**	73	24/10/08	**579**		90		350	10/11/08	17	-225
Org	Nov	18	Cos	Goblin	25%	1997	1997	575	26/10/08	1 - 11-31/2e,2&13/4e	**12/08/08**	73	24/10/08	**207**		90		350	10/11/08	17	-225
Con	Nov	20	Cos	Avidius	70%	5618	5618	575	9/11/2008	1 - 15-2 & 14-3 & 21-1&2	**09/09/08**	64	12/11/08	**42**		71		350	19/11/08	7	-225
Org	Nov	20	Cos	Goblin	25%	2006	2006	575	9/11/2008	1 - 15-3	**09/09/08**	64	12/11/08	**582**				na	09/09/08	-64	na
Con	Nov	20	Cos	RZ 4193	5%	401	401	575	9/11/2008	1 - 20-1	**09/09/08**	64	12/11/08	**208**				na	09/09/08	-64	na
Org	Dec	22	Cos	Avidius	70%	5643	5643	575	23/11/08	1 - 22-5&6 & 23 1,2,3	**23/09/08**	59	21/11/08	860		76		400	08/12/08	17	-175
Con	Dec	22	Cos	Goblin	25%	2016	2016	575	23/11/08	1 - 23-3 & 28-4&5	**23/09/08**	59	21/11/08	300				na	23/09/08	-59	na
Org	Dec	22	Cos	Avidius			0	575	23/11/08	2 - 21-6	**02/10/08**	56	27/11/08	**200**		74		400	15/12/08	18	-175
Con	Dec	22	Cos	Goblin			0	575	23/11/08	2 - 21-4&5	**02/10/08**	56	27/11/08	**120**				na	02/10/08	-56	na
Org	Dec	24	Cos	Avidius	70%	5669	5669	575	7/12/2008	2 - 25-4-6 & 26-2	**14/10/08**	54	07/12/08	**800**				na	14/10/08	-54	na
Con	Dec	24	Cos	Goblin	25%	2025	2025	575	7/12/2008	2 - 26 - 3	**14/10/08**	54	07/12/08	**280**				na	14/10/08	-54	na
Org	Dec	24	Cos	RZ 4193	5%	405	405	575	7/12/2008	2 - 26 - 2	**14/10/08**	54	07/12/08	**60**				na	14/10/08	-54	na

Con	Dec	26	Cos	Avidius	70%	7103	7103	575	21/12/08	K2.28.1 - 5	**28/10/08**	52	19/12/08	**1030**				na	28/10/08	-52	na
Org	Dec	26	Cos	Goblin	25%	2537	2537	575	21/12/08	K1 - 1. 1.5	**28/10/08**	52	19/12/08	**360**				na	28/10/08	-52	na
Con	Jan	28	Cos	Avidius	60%	6262	6262	575	4/01/2009	K2.16.1-5	**18/11/08**	48	05/01/09	**950**		77		450	03/02/09	29	-125
Org	Jan	28	Cos	Goblin	20%	2087	2087	575	4/01/2009	K2.16.5& 17.1-2	**18/11/08**	48	05/01/09	**390**				na	18/11/08	-48	na
Con	Jan	28	Cos	Glory	15%	1566	1566	575	4/01/2009	K2.17.3	**18/11/08**	48	05/01/09	**15**				na	18/11/08	-48	na
Org	Jan	28	Cos	Quintus	5%	522	522	575	4/01/2009	K2.17.2-3	**18/11/08**	48	05/01/09	**75**				na	18/11/08	-48	na
Con	Jan	30	Cos	Avidius	60%	6149	6149	575	18/01/09	K2.19.1-6	**02/12/08**	47	18/01/09	**980**		76		500	16/02/09	29	-75
Org	Jan	30	Cos	Goblin	20%	2050	2050	575	18/01/09	K2.19.6& 2.11.4-5	**02/12/08**	47	18/01/09	**330**				na	02/12/08	-47	na
Con	Jan	30	Cos	Glory	15%	1537	1537	575	18/01/09	K2.11.3& 4	**02/12/08**	47	18/01/09	**210**				na	02/12/08	-47	na
Org	Jan	30	Cos	RZ 4193	5%	512	512	575	18/01/09	K2.11.5& 4	**02/12/08**	47	18/01/09	**240.00**				na	02/12/08	-47	na
Con	Feb	32	Cos	Avidius	60%	6020	6020	575	1/02/2009	K1.16.1-4&1.17.6	**16/12/08**	46	31/01/09	**860**		62		400	16/02/09	16	-175
Org	Feb	32	Cos	Goblin	20%	2007	2007	575	1/02/2009	K1.141&1.16.4-5	**16/12/08**	46	31/01/09	**275**				na	16/12/08	-46	na
Con	Feb	32	Cos	Glory	15%	1505	1505	575	1/02/2009	k1.14.1&2	**16/12/08**	46	31/01/09	**310**				na	16/12/08	-46	na
Org	Feb	32	Cos	RZ 4193	5%	502	502	575	1/02/2009	K1.14.2	**16/12/08**	46	31/01/09	**90**				na	16/12/08	-46	na
Con	Feb	34	Cos	Avidius	60%	5612	5612	575	15/02/09	K1.4.1-5&K2.5.1-3	**30/12/08**	46	14/02/09	**1350**		65		350	05/03/09	19	-225
Org	Feb	34	Cos	Cosmic	15%	1403	1403	575	15/02/09	K1.4.5&L. 3.1	**30/12/08**	46	14/02/09	**60**				na	30/12/08	-46	na
Con	Feb	34	Cos	RZ 4193	5%	468	468	575	15/02/09	K1.3.1	**30/12/08**	46	14/02/09	**190**				na	30/12/08	-46	na
Org	Mar	36	Cos	Avidius	60%	5531	5531	575	1/03/2009	K1.2.6&K 2.7.1-5	**13/01/09**	47	01/03/09	**1110**		63		450	17/03/09	16	-125
Con	Mar	36	Cos	Glory	15%	1383	1383	575	1/03/2009	K2.7.1&8. 1	**13/01/09**	47	01/03/09	**280**				na	13/01/09	-47	na

Org	Mar	36	Cos	RZ 4193	5%	461	461	575	1/03/09	K2.8.1&2	**13/01/09**	47	01/03/09	**90**				na	13/01/09	-47	na
Con	Mar	38	Cos	Glory	15%	1343	1343	575	15/03/09	K1.50.5&6	**27/01/09**	48	16/03/09	**220**				na	27/01/09	-48	na
Org	Mar	38	Cos	RZ 4193	5%	448	448	575	15/03/09	K1.50.6	**27/01/09**	48	16/03/09	**40**				na	27/01/09	-48	na
Con	Nov	18	Iceb	Kong	40%	2976	2976	650	26/10/08	1 - 13-3&2	**07/08/08**	82	28/10/08	**280**				na	07/08/08	-82	na
Org	Nov	18	Iceb	Marksman	40%	2976	2976	650	26/10/08	1 - 12-5&6	**07/08/08**	82	28/10/08	**300**				na	07/08/08	-82	na
Con	Nov	18	Iceb	Gaitlin	15%	1116	1116	650	26/10/08	1 - 13 -1	**07/08/08**	82	28/10/08	**130**				na	07/08/08	-82	na
Org	Nov	18	Iceb	Sureshot	5%	372	372	650	26/10/08	1 - 13-2&1	**07/08/08**	82	28/10/08	**40**		95		600	10/11/08	13	-50
Con	Nov	20	Iceb	Kong	40%	2990	2990	650	9/11/2008	1 - '10-6	**19/08/08**	82	09/11/08	**273**				na	19/08/08	-82	na
Org	Nov	20	Iceb	Marksman	40%	2990	2990	650	9/11/2008	1 - 13-4&5	**19/08/08**	82	09/11/08	**273**				na	19/08/08	-82	na
Con	Nov	20	Iceb	Gaitlin	15%	1121	1121	650	9/11/2008	1 - 13-6+11-1	**19/08/08**	82	09/11/08	**102**				na	19/08/08	-82	na
Org	Nov	20	Iceb	Sureshot	5%	374	374	650	9/11/2008	1 - 13 - 5	**19/08/08**	82	09/11/08	**34**		92		600	19/11/08	10	-50
Con	Dec	22	Iceb	Kong	40%	3003	3003	650	23/11/08	1 - 19-4&5	**05/09/08**	82	26/11/08	**385**				na	05/09/08	-82	na
Org	Dec	22	Iceb	Marksman	40%	3003	3003	650	23/11/08	1 - 19-5&6	**05/09/08**	82	26/11/08	**385**				na	05/09/08	-82	na
Con	Dec	22	Iceb	Gaitlin	15%	1126	1126	650	23/11/08	1 - 19-6 & 20-1	**05/09/08**	82	26/11/08	**144**				na	05/09/08	-82	na
Org	Dec	24	Iceb	Kong	20%	1509	1509	650	7/12/08	1 - 22-3&4	**17/09/08**	82	08/12/08	**193**				na	17/09/08	-82	na
Con	Dec	24	Iceb	Marksman	20%	1509	1509	650	7/12/08	1 - 22-2&3	**17/09/08**	82	08/12/08	**193**				na	17/09/08	-82	na
Org	Dec	24	Iceb	Gaitlin	10%	754	754	650	7/12/2008	1 - 22-5	**17/09/08**	82	08/12/08	**96**				na	17/09/08	-82	na
Con	Dec	24	Iceb	Silverado	30%	2263	2263	650	7/12/2008	1 - 22-1	**17/09/08**	82	08/12/08	**290**				na	17/09/08	-82	na
Org	Dec	24	Iceb	Categenus	10%	754	754	650	7/12/2008	1 - 22-1 & 21-6	**17/09/08**	82	08/12/08	**96**				na	17/09/08	-82	na

Con	Dec	24	Iceb	Lagunas	10%	754	754	650	7/12/2008	1 - 22-4&5	**17/09/08**	82	08/12/08	**96**				na	17/09/08	-82	na
Org	Dec	24	Iceb	Gaitlin			0	650	7/12/2008	1 - 28-3 & 29-1	**25/09/08**	82	16/12/08	**50**				na	25/09/08	-82	na
Con	Dec	24	Iceb	Kong			0	650	7/12/2008	1 -28-3	**25/09/08**	82	16/12/08	**90**				na	25/09/08	-82	na
Org	Dec	24	Iceb	Marksman			0	650	7/12/2008	1 - 28-2&3	**25/09/08**	82	16/12/08	**100**				na	25/09/08	-82	na
Con	Dec	24	Iceb	Silverado			0	650	7/12/2008	1 - 28 - 2	**25/09/08**	82	16/12/08	**60**				na	25/09/08	-82	na
Org	Dec	24	Iceb	Categenus			0	650	7/12/2008	1 - 29-1	**25/09/08**	82	16/12/08	**70**				na	25/09/08	-82	na
Con	Dec	24	Iceb	Silverado			0	650	7/12/2008	2 - 21-4	**02/10/08**	82	23/12/08	**120**		69		600	10/12/08	-13	-50
Org	Dec	24	Iceb	Marksman			0	650	7/12/2008	2 - 21-4	**02/10/08**	82	23/12/08	**100**				na	02/10/08	-82	na
Con	Dec	24	Iceb	Categenus			0	650	7/12/2008	2 - 21-5	**02/10/08**	82	23/12/08	**50**				na	02/10/08	-82	na
Org	Dec	24	Iceb	Gaitlin			0	650	7/12/2008	2 - 21-5	**02/10/08**	82	23/12/08	**50**				na	02/10/08	-82	na
Con	Dec	24	Iceb	Kong			0	650	7/12/2008	2 - 21-5	**02/10/08**	82	23/12/08	**100**				na	02/10/08	-82	na
Org	Dec	24	Iceb	Gaitlin			0	650	7/12/2008	2 - 25-4	**07/10/08**	82	28/12/08	**40**				na	07/10/08	-82	na
Con	Dec	24	Iceb	Marksman			0	650	7/12/2008	2 - 25-3	**07/10/08**	82	28/12/08	**200**				na	07/10/08	-82	na
Org	Dec	24	Iceb	Silverado			0	650	7/12/2008	2 - 25-3&4	**07/10/08**	82	28/12/08	**170**				na	07/10/08	-82	na
Con	Dec	24	Iceb	Categenus			0	650	7/12/2008	2 - 25-4	**07/10/08**	82	28/12/08	**40**				na	07/10/08	-82	na
Con	Dec	26	Iceb	Silverado	60%	5671	5671	650	21/12/08	2 - 6.2-5	**21/10/2008**	60	20/12/08	**620**				na	21/10/08	-60	na
Org	Dec	26	Iceb	Categenus	20%	1890	1890	650	21/12/08	2 - 6.1 & 7.5	**21/10/2008**	60	20/12/08	**270**				na	21/10/08	-60	na
Con	Dec	26	Iceb	Lagunas	20%	1890	1890	650	21/12/08	2 - 6.1-2	**21/10/2008**	60	20/12/08	**390**				na	21/10/08	-60	na

Org	Jan	28	Iceb	Gaitlin	50%	3500	3500	650	4/01/2009	K2.35	**07/11/08**	57	03/01/09	**485**				na	07/11/08	-57	na
Con	Jan	28	Iceb	Seagull	5%	350	350	650	4/01/2009	K2.33	**07/11/08**	57	03/01/09	**48**				na	07/11/08	-57	na
Org	Jan	28	Iceb	Silverado	45%	3150	3150	650	4/01/2009	K2.1.3-6	**11/11/08**	57	07/01/09	**460**		70		600	20/01/09	13	-50
Con	Jan	30	Iceb	Gaitlin	50%	3500	3500	650	18/01/09	K2.14.1-5	**18/11/08**	54	11/01/09	**940**				na	18/11/08	-54	na
Org	Jan	30	Iceb	Seagull	5%	350	350	650	18/01/09	k2.15.5	**18/11/08**	54	11/01/09	**70**				na	18/11/08	-54	na
Con	Feb	32	Iceb	Gaitlin	45%	3150	3150	650	1/02/2009	K1.18.4-6	**02/12/08**	57	28/01/09	**400**		63		750	03/02/09	6	100
Org	Feb	32	Iceb	Seagull	5%	350	350	650	1/02/2009	K1.18.6	**02/12/08**	57	28/01/09	**50**		63		750	03/02/09	6	100
Con	Feb	34	Iceb	Gaitlin	50%	3250	3250	650	15/02/09	K1.17.5&6	**16/12/08**	57	11/02/09	**208**		56		750	10/02/09	-1	100
Org	Feb	34	Iceb	Steamboat	5%	325	325	650	15/02/09	K1.17.6	**16/12/08**	57	11/02/09	**250**		56		750	10/02/09	-1	100
Con	Feb	34	Iceb	Silverado	45%	2925	2925	650	15/02/09	K1.12.1-2	**23/12/08**	57	18/02/09	**390**				na	23/12/08	-57	na
Org	Mar	36	Iceb	Gaitlin	50%	3250	3250	650	1/03/2009	K1.11.2-4	**30/12/08**	57	25/02/09	**350**		65		750	05/03/09	8	100
Con	Mar	36	Iceb	Seagull	5%	325	325	650	1/03/2009	K1.11.4	**30/12/08**	57	25/02/09	**60**		65		750	05/03/09	8	100
Org	Mar	36	Iceb	Silverado	45%	2925	2925	650	1/03/2009	K1.13.3-5	**06/01/09**	57	04/03/09	**400**				na	06/01/09	-57	na
Org	Oct	14	Spin	Pelican	20%	404	484	1.04	28/09/08	2 - 8-4,5,6	**15/08/08**	45	29/09/08	**600**	11	73	1.3		27/10/08	28	0.26
Con	Nov	14	Spin	Roadrunner	60%	1211	1453	1.04	28/09/08	2 - 7-4,5,6	**15/08/08**	45	29/09/08	**600**	11	73	1.3		27/10/08	28	0.26
Org	Jun	16	Spin	Pelican	20%	405	486	1.04	12/10/08	2 - 17-3&4	**25/08/08**	45	09/10/08	**400**	11	73	1.49		06/11/08	28	0.45
Con	Jul	16	Spin	Nighthawk	20%	405	486	1.04	12/10/08	2 - 17-4&5	**27/08/08**	45	11/10/08	**400**	11	73	1.49		08/11/08	28	0.45
Org	Aug	16	Spin	Roadrunner	60%	1216	1459	1.04	12/10/08	2 - 18-2,3&4	**29/08/08**	45	13/10/08	**1000**	11	73	1.49		10/11/08	28	0.45
Con	Nov	18	Spin	Roadrunner	60%	1222	1466	1.04	26/10/08	1 - 17-4,5&6 18-1-6	**05/09/08**	45	20/10/08	**3000**	9	52	1.4		27/10/08	7	0.36

Org	Nov	18	Spin	Nighthawk	20%	407	489	1.04	26/10/08	1 - 16-1,2&3	**05/09/08**	45	20/10/08	**500**	9	52	1.75		27/10/08	7	0.71
Con	Nov	18	Spin	Pelican	20%	407	489	1.04	26/10/08	2 - 20-3&4	**08/09/08**	45	23/10/08	**680**	9	52	1.22		30/10/08	7	0.18
Org	Nov	20	Spin	Roadrunner	60%	1227	1473	1.04	9/11/2008	1 - 23-4-6 & 24-1,2&3	**17/09/08**	40	27/10/08	**1010**	9	54	2.16		10/11/08	14	1.12
Con	Nov	20	Spin	Nighthawk	20%	409	491	1.04	9/11/2008	1 - 25-2&3	**17/09/08**	40	27/10/08	**340**	9	49	0.92		05/11/08	9	-0.12
Con	Dec	24	Spin	Greyhound		2064	2477	1.04	7/12/2008	K2.35.4&2.8.1&2.7.1	**07/11/08**	35	12/12/08	**3800**	9	40	1.62		17/12/08	5	0.58
Org	Dec	24	Spin							K2.35.3	**04/11/08**	35	09/12/08	**310**	7	43	1.62		17/12/08	8	1.62
Org	Dec	26	Spin	Crocodile		3039	3647	1.04	21/12/08	K2.38.4 -	**21/11/08**	35	26/12/08	**2540**	7	43	2		03/01/09	8	0.96
Con	Jan	28	Spin	PV0495F1		2367	2840	1.04	4/01/2009	K1.49.2&3&1.50.4	**06/12/08**	35	10/01/09	**1800**	7	39	1.56		14/01/09	4	0.52
Org	Jan	30	Spin			2305	2766	1.04	18/01/2009	K2.51.1&2.52.4-6	**19/12/08**	35	23/01/09	**1200**	7	39	1.56		27/01/09	4	0.52
Con	Feb	34	Spin	Crocodile		2161	2593	1.04	15/02/09	K1.43.4-6	**16/01/09**	35	20/02/09	**3880**	7	40	1.7		25/02/09	5	0.66
Org	Mar	36	Spin	Crocodile		2189	2627	1.04	1/03/2009	K2.30.1,3,6&32.1,3,6&41.1	**30/01/09**	35	06/03/09	**4014.00**	9	53	1.6		24/03/09	18	0.56
Con	Mar	38	Spin	Toucan		2161	2593	1.04	15/03/09	K1.40.1,3,6 &k2.28.1,3,6 &K2.43.1	**13/02/09**	35	20/03/09	**2676.00**	9	42	1.4		27/03/09	7	0.36

Appendix 6 - Optimal germination and growth parameters by location

Baby-leaf Spinach (Spinacia oleracea) and Lettuce (Lactuca sativa)

Spinach (Spinacia oleracea)

	Germination (^{o}C)	Growth (^{o}C)	Mapping limits
Min	2	5	Min. = 2
Optimum Range	7-24	15-18 (14-24 for max quality)	Max. night = 15
Max	30 **	32	Max. = 30

Notes:

1. soil temperature above 30 ^{o}C for germination is a limiting factor
2. 14-24 ^{o}C growth for maximum quality
3. 20 ^{o}C reduces yield thru higher plant respiration.
4. --------- denotes min and max temp growth limits
5. ——— denotes optimum range for best quality

Lettuce (Lactuca sativa)

	Germination (^{o}C)	Growth (^{o}C)	Mapping limits
Min	2.2	7	Min. = 7
Optimum Range	18-21	12-21	Max. night = 15
Max	27 **	24	Max. = 24

Notes:

1. high temperature dormancy above 27^{o}C. is a limitation
2. germination at 0^{o}C. = 49 days, and at 5^{o}C. = 15 days (see optimum range)
3. --------- denotes min and max temp growth limits
4. ——— denotes optimum range for best quality

** = limiting factors

Suitability of potential growing regions in Australia

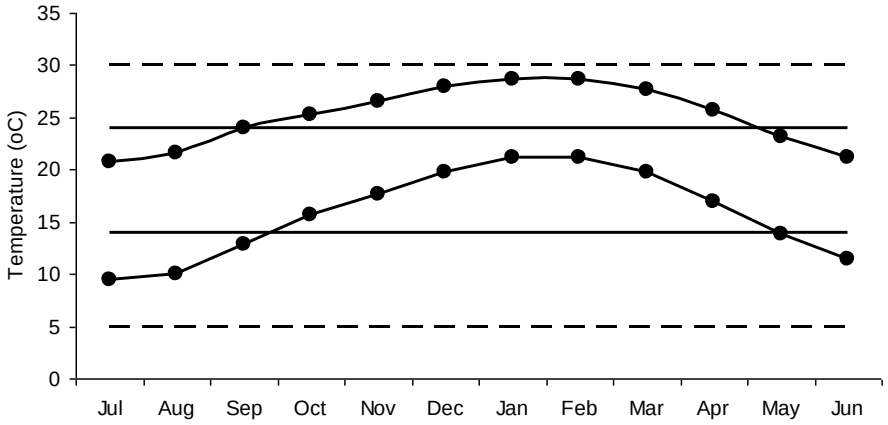
- Queensland
- New South Wales
- Victoria
- South Australia
- Tasmania
- Northern Territory
- Western Australia
- USA (Comparison)

Queensland

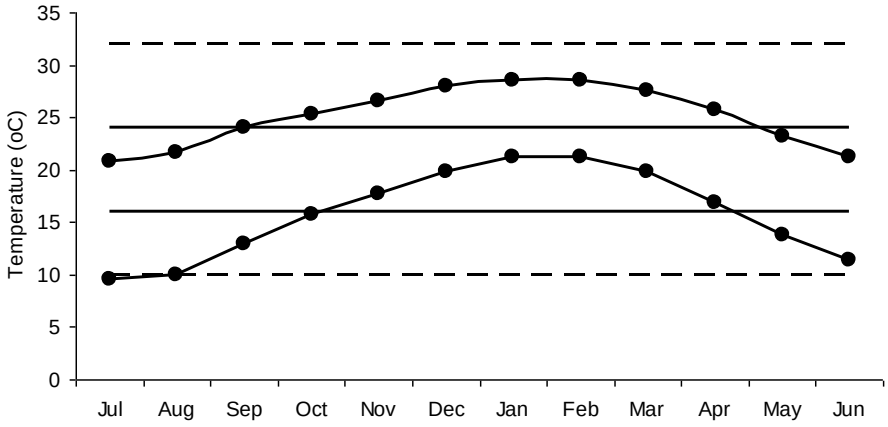
Maroochydore

Elevation: 3 m

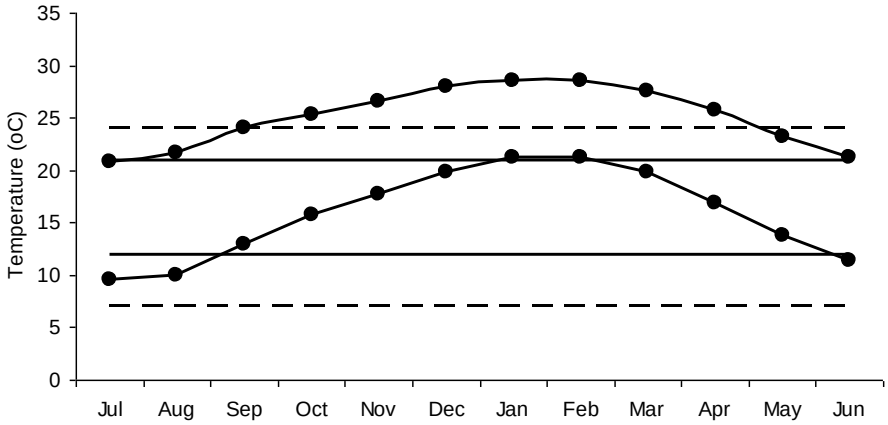
Spinach



European Wild Rocket



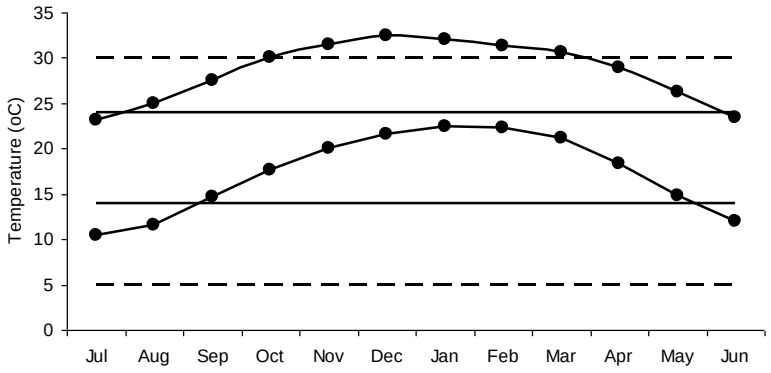
Lettuce



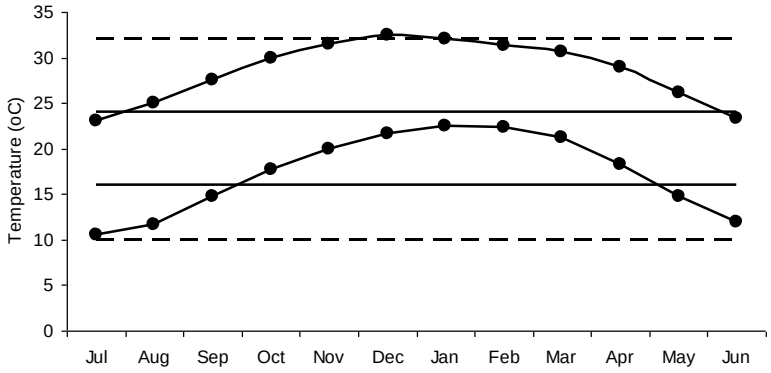
Rockhampton

Elevation: 10 m

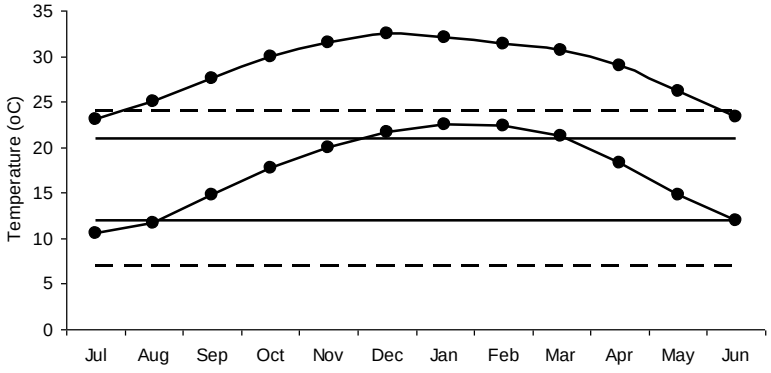
Spinach



European Wild Rocket



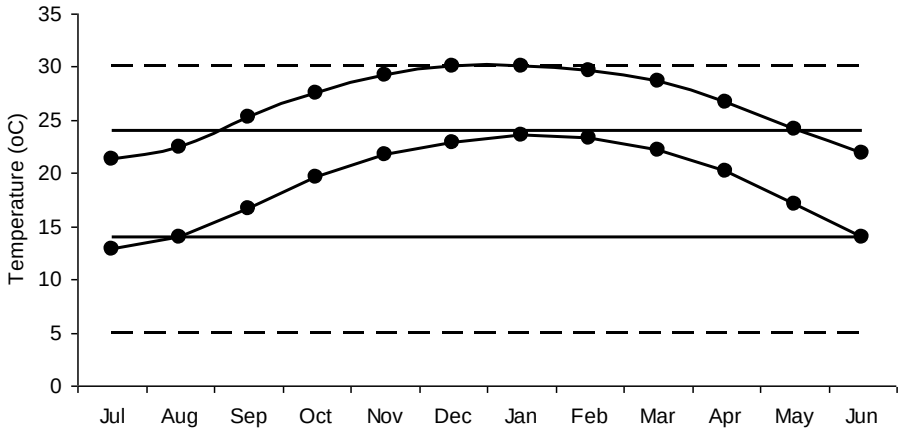
Lettuce



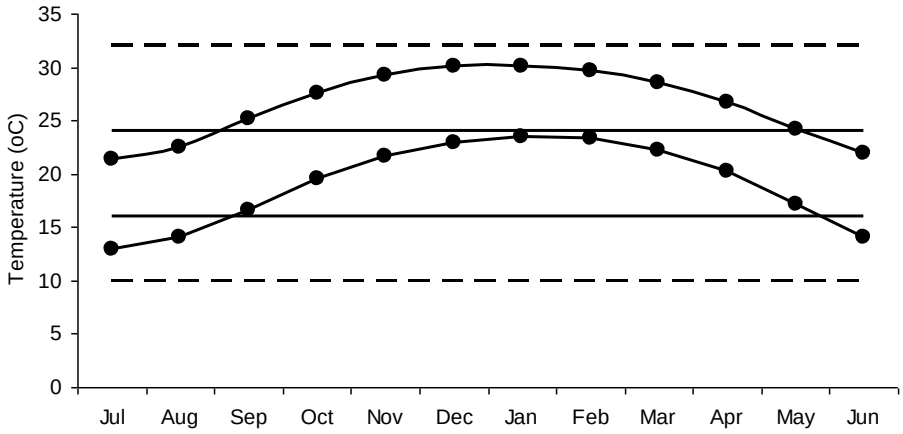
Mackay

Elevation: 30 m

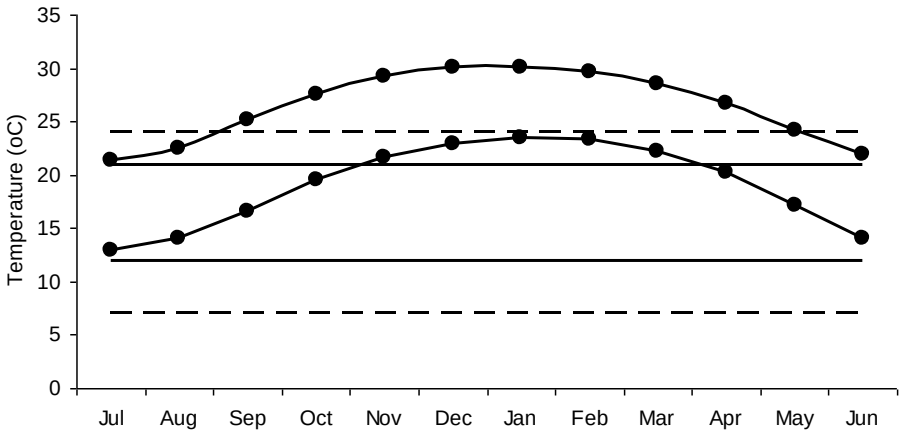
Spinach



European Wild Rocket



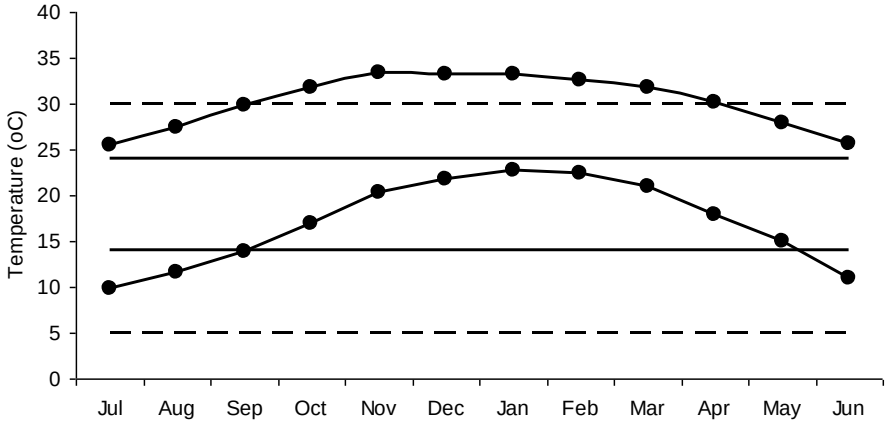
Lettuce



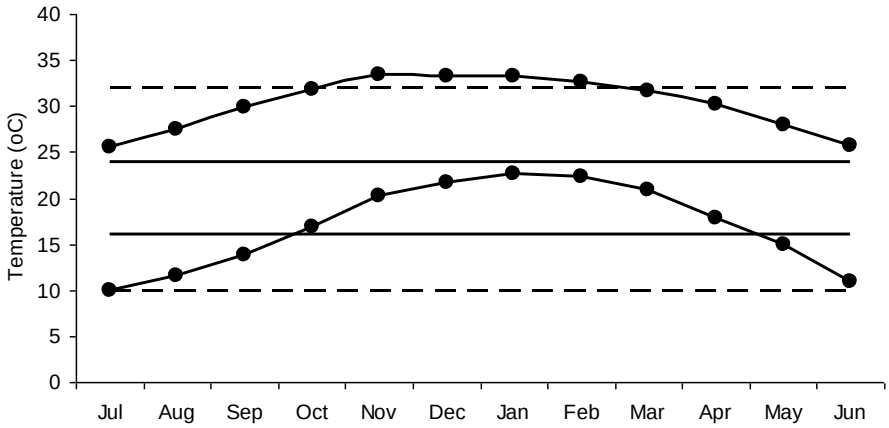
Millaroo

Elevation: 45 m

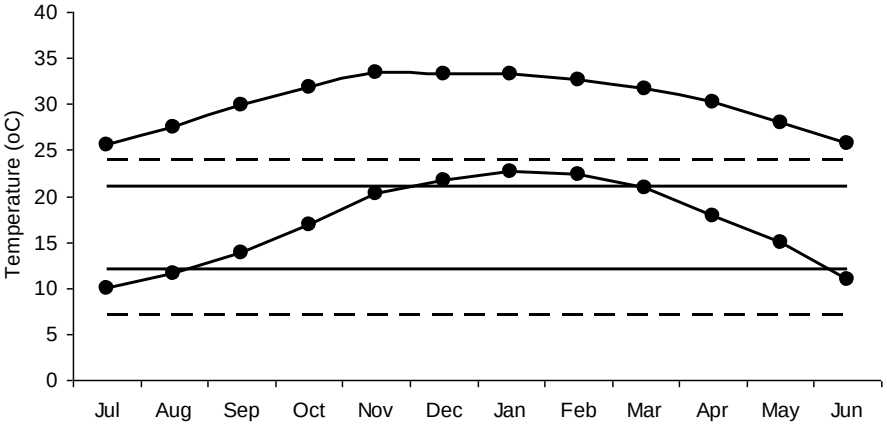
Spinach



European Wild Rocket



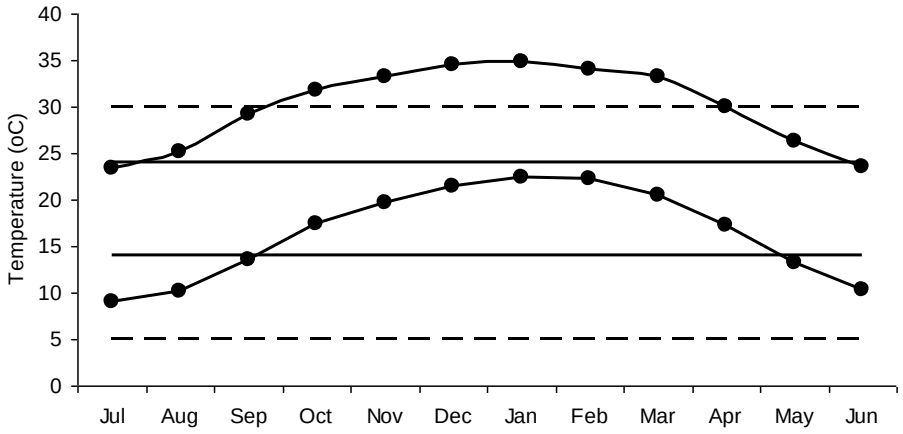
Lettuce



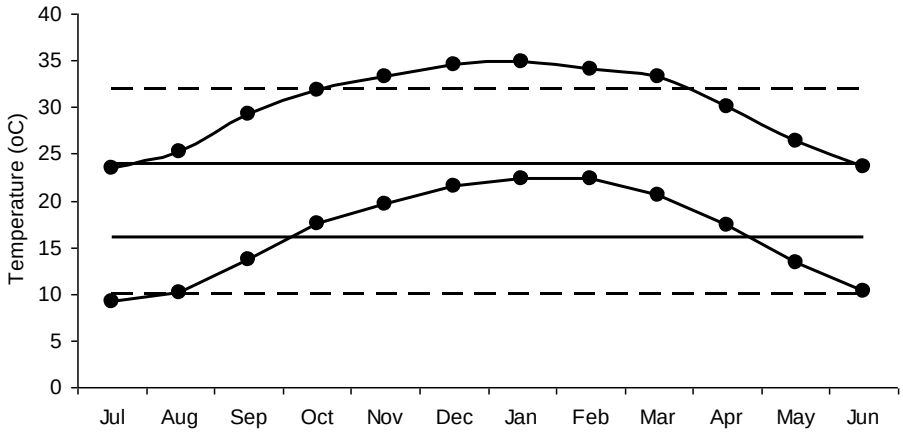
Emerald

Elevation: 189 m

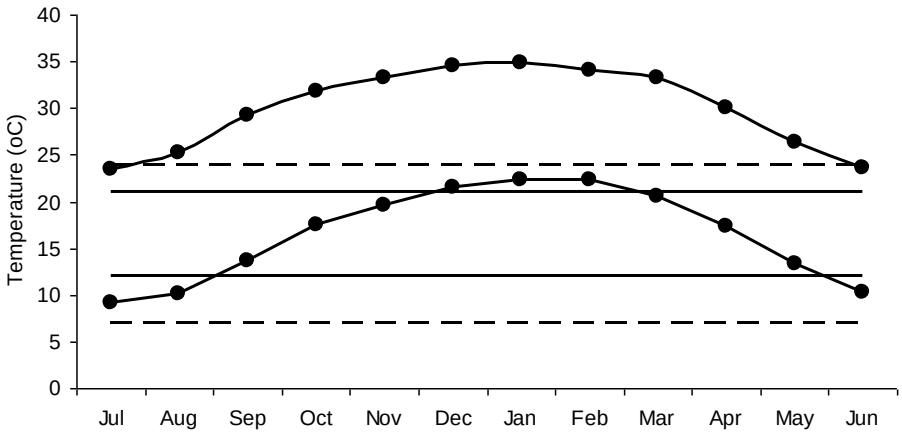
Spinach



European Wild Rocket



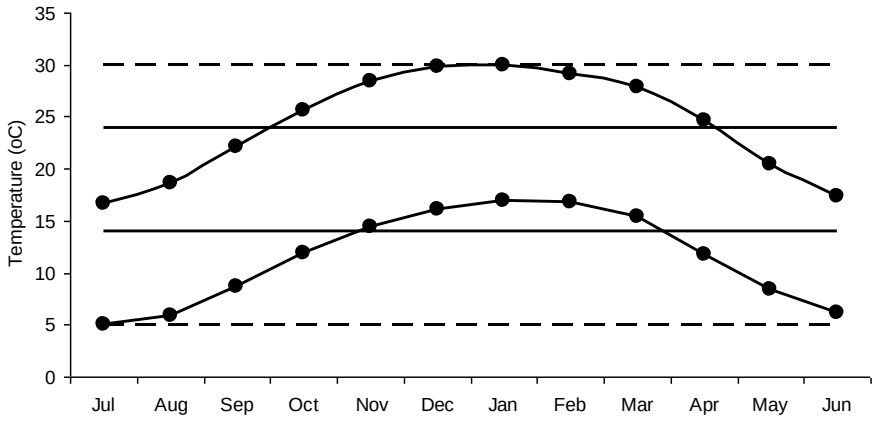
Lettuce



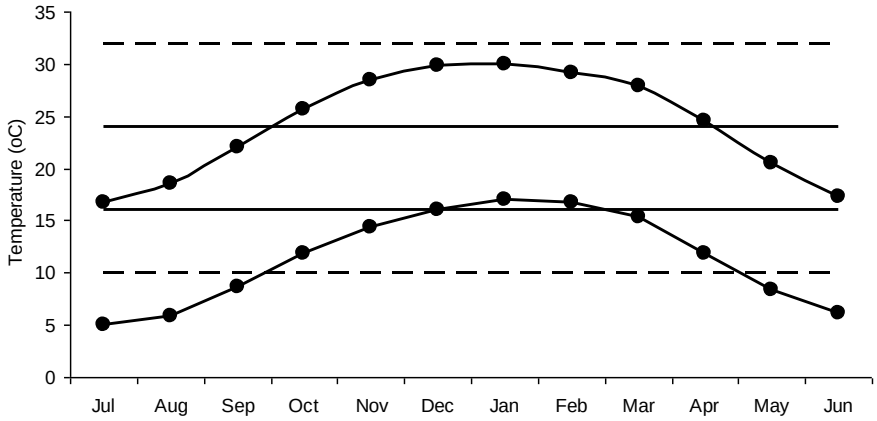
Pittsworth/Brookstead

Latitude:-27.7156 S Longitude: 151.6333 E Elevation: 608.0 m

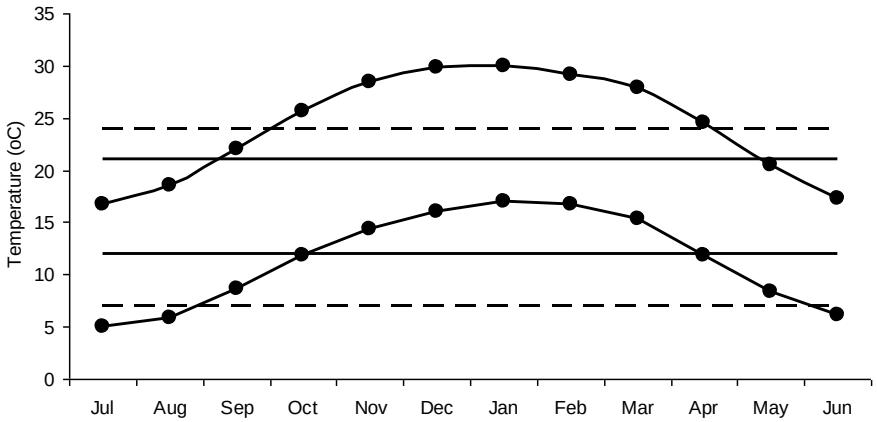
Spinach



European Wild Rocket



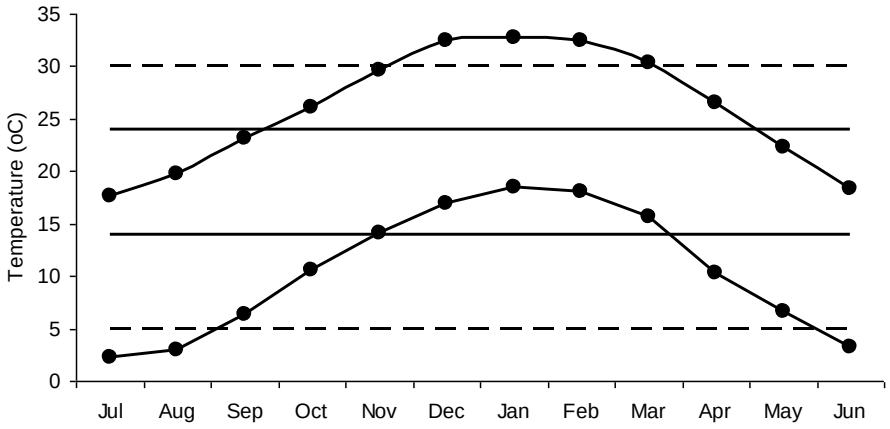
Lettuce



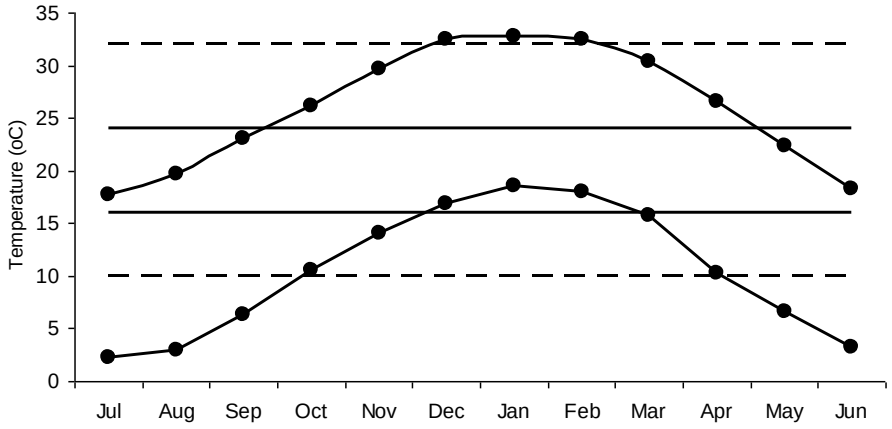
Inglewood

Latitude:-28.5000 S Longitude: 150.9333 E Elevation: 265.0 m

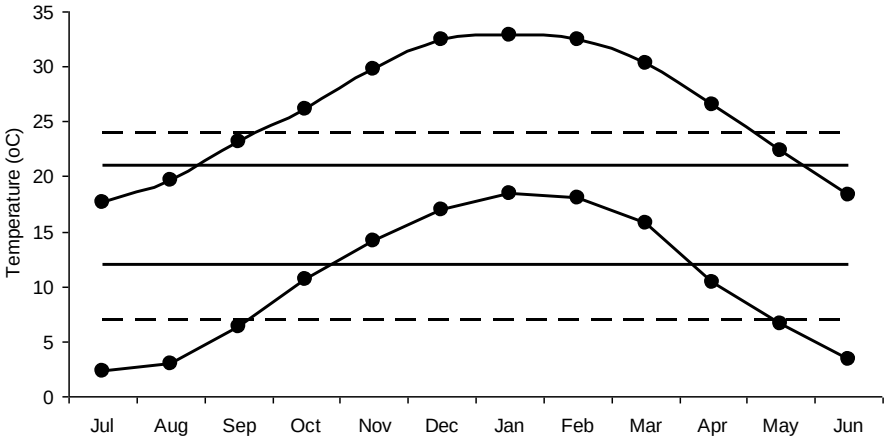
Spinach



European Wild Rocket



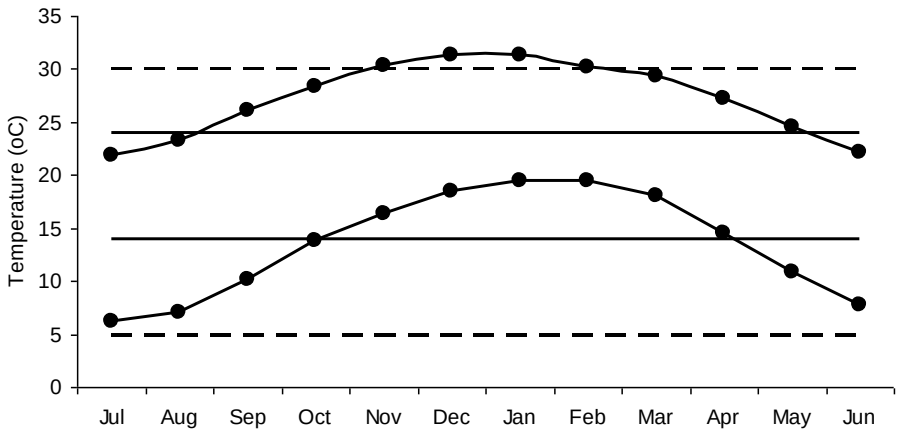
Lettuce



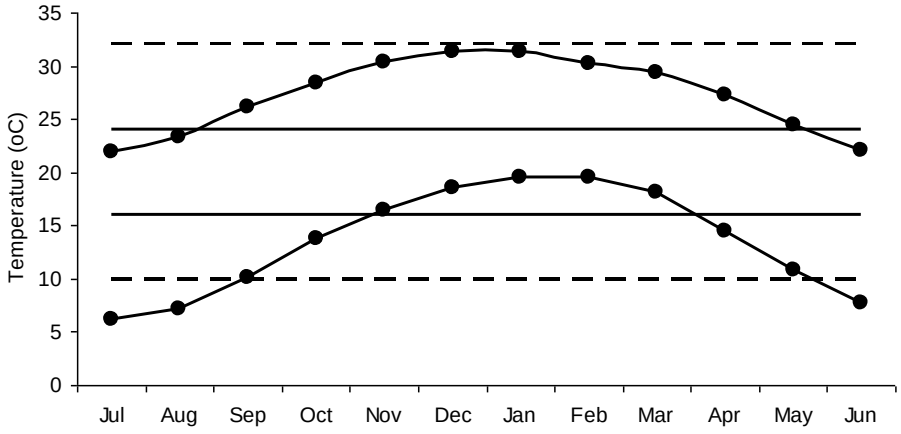
Gympie

Latitude:-26.1831 S Longitude: 152.6414 E Elevation: 64.5 m

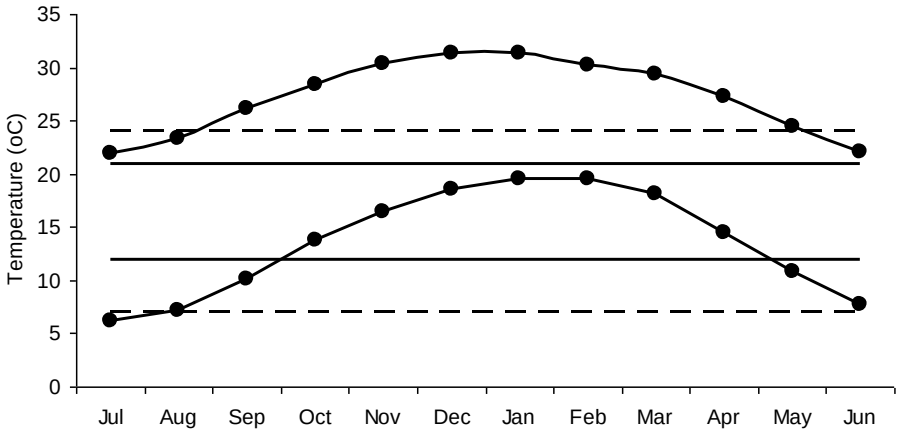
Spinach



European Wild Rocket



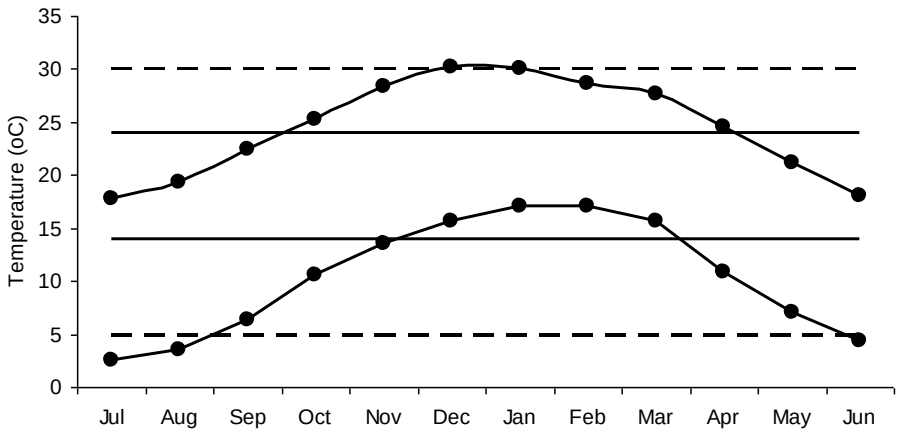
Lettuce



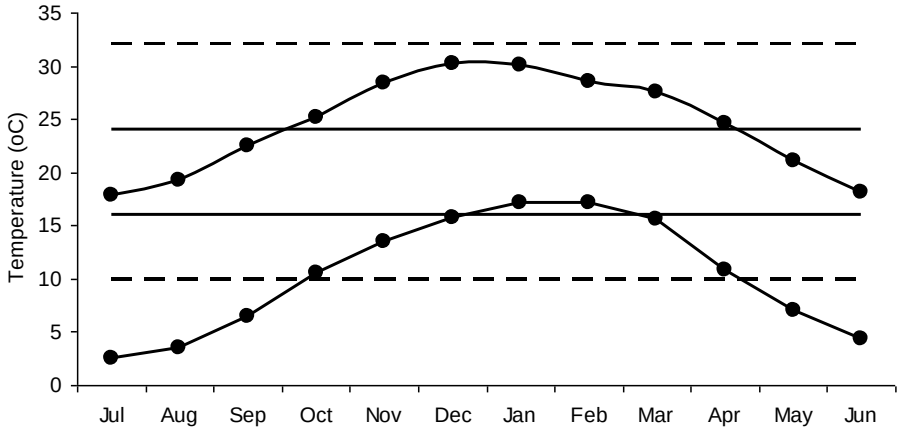
Warwick

Latitude:-28.2167 S Longitude: 152.0333 E Elevation: 453.0 m

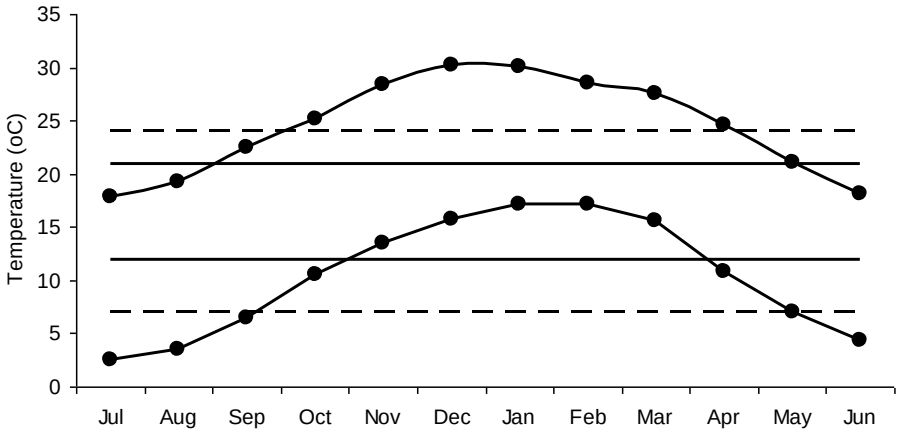
Spinach



European Wild Rocket



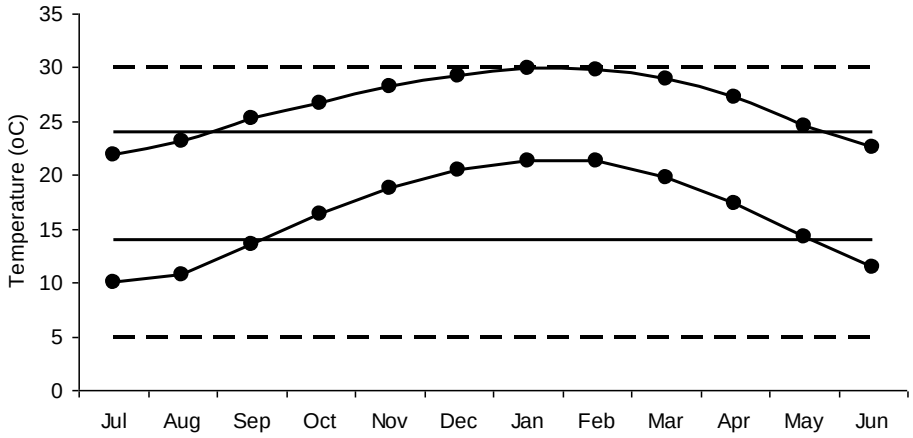
Lettuce



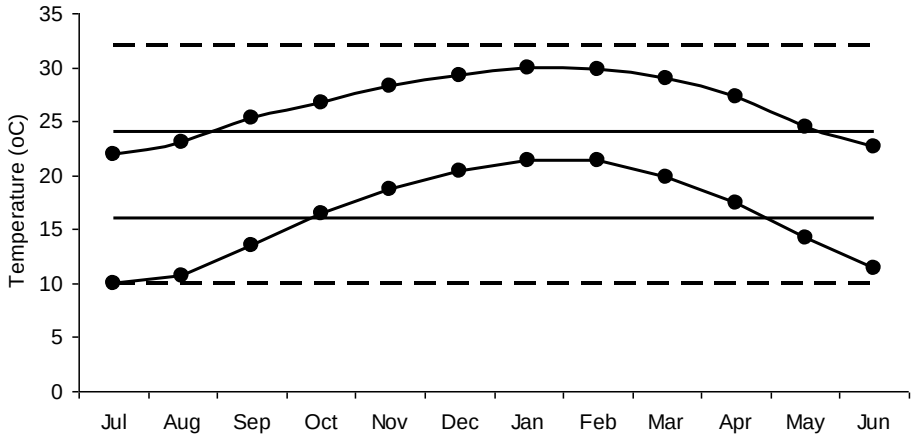
Bundaberg

Latitude:-24.8885 S Longitude: 152.3235 E Elevation: 27.0 m

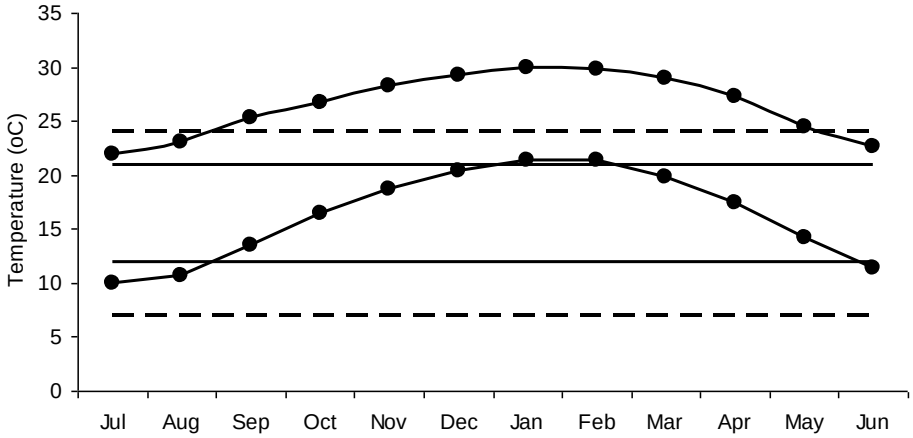
Spinach



European Wild Rocket



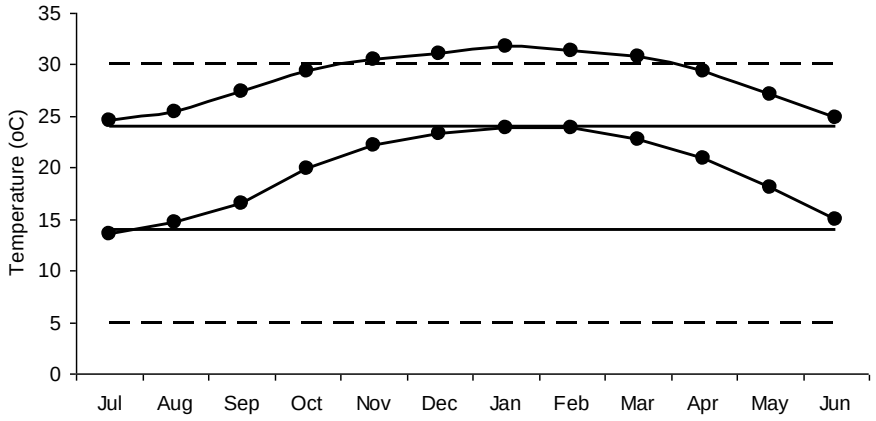
Lettuce



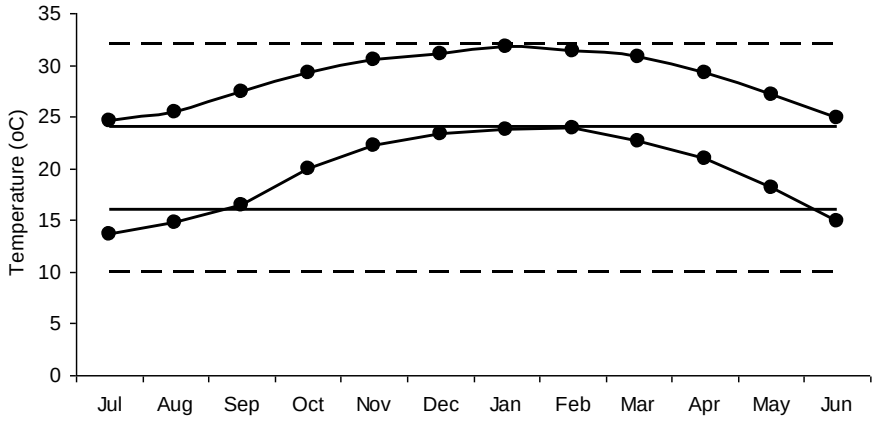
Bowen

Latitude:-20.0150 S Longitude: 148.2153 E Elevation: 5.0 m

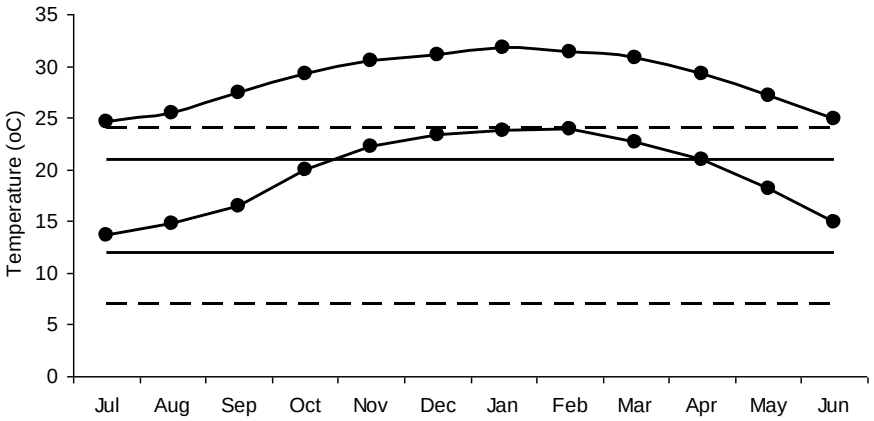
Spinach



European Wild Rocket



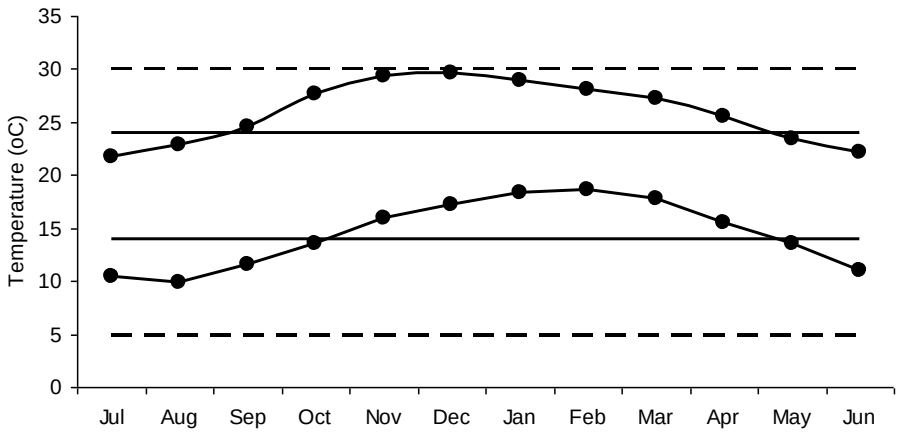
Lettuce



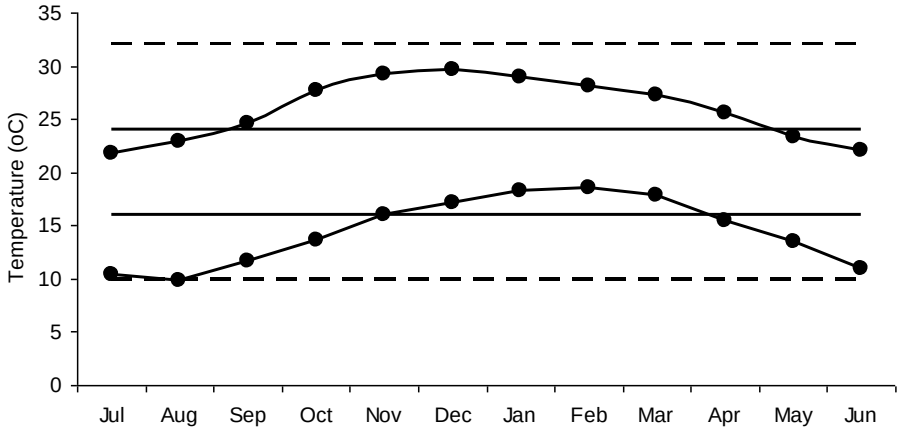
Atherton

Latitude:-17.2667 S Longitude: 145.4833 E Elevation: 752.0 m

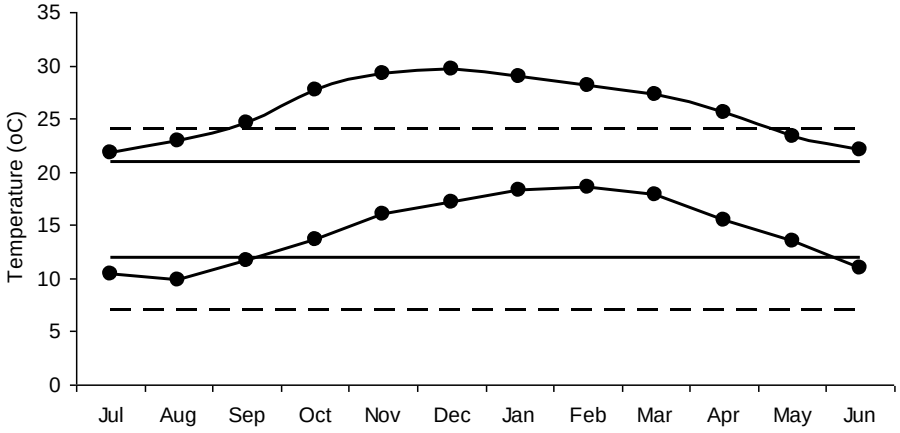
Spinach



European Wild Rocket



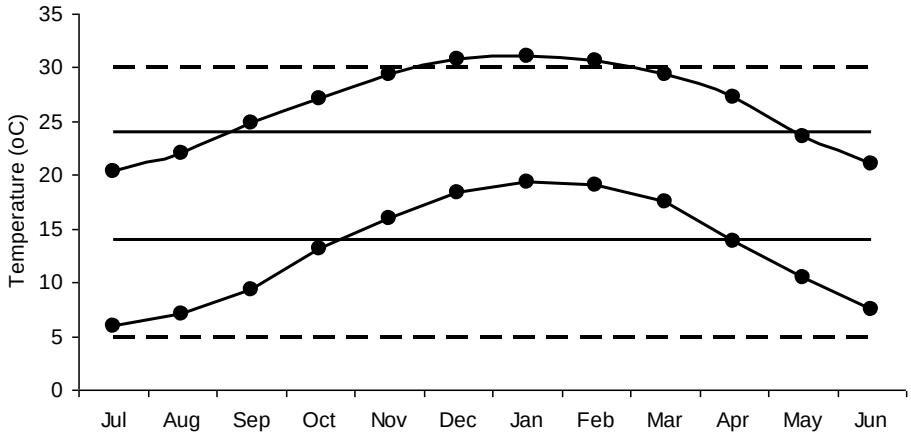
Lettuce



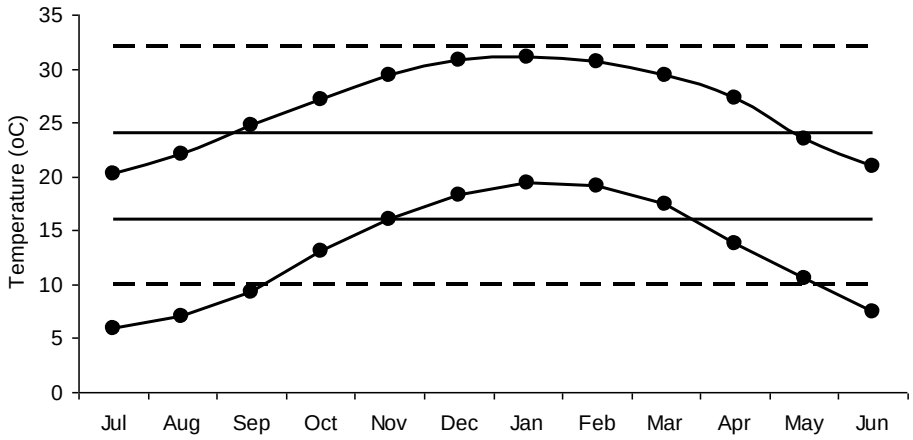
Gatton (Lawes)

Lat. 27o33' S Long.152o20' E Elev. 29m

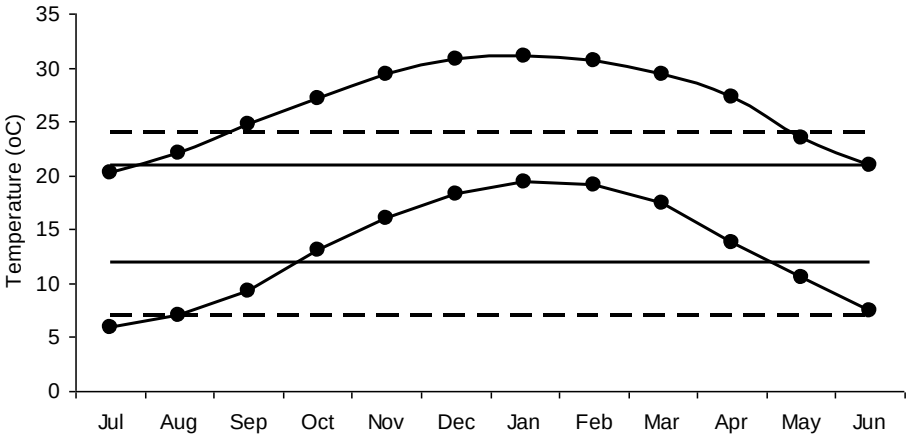
Spinach



European Wild Rocket



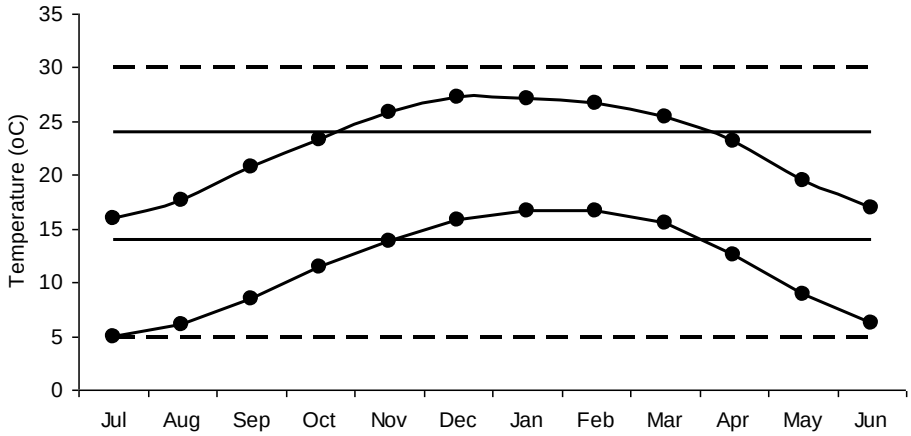
Lettuce



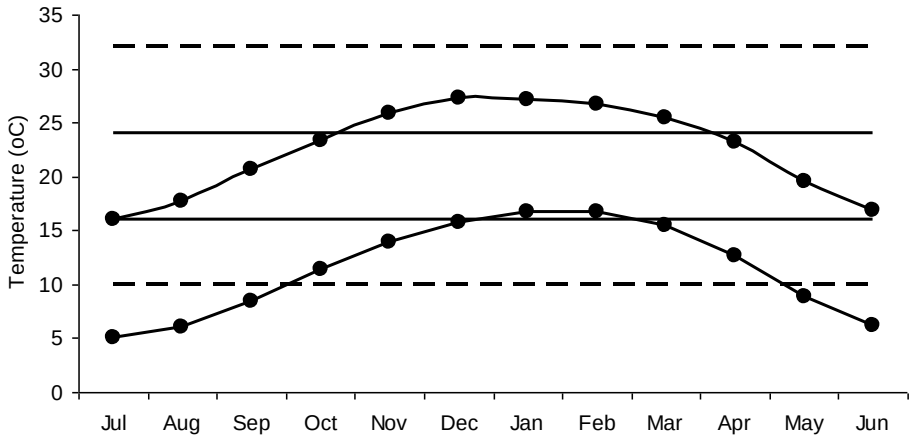
Toowoomba

Lat. 27o 35' S Long. 151o 56' Elev. 675 m

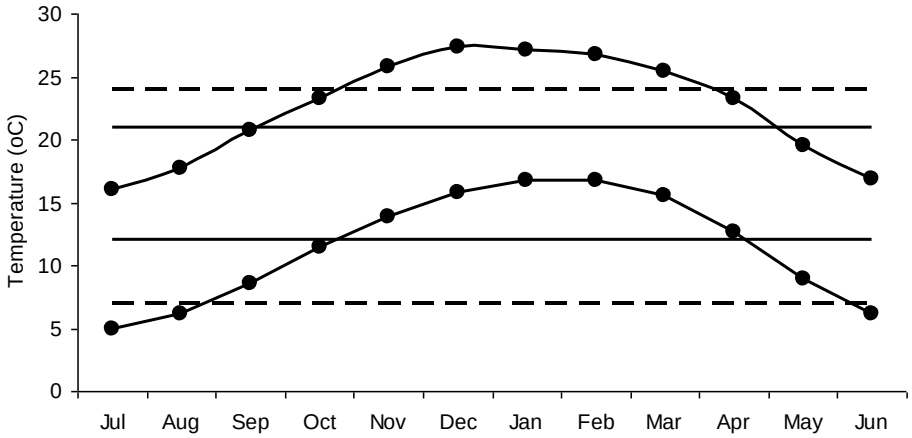
Spinach



European Wild Rocket



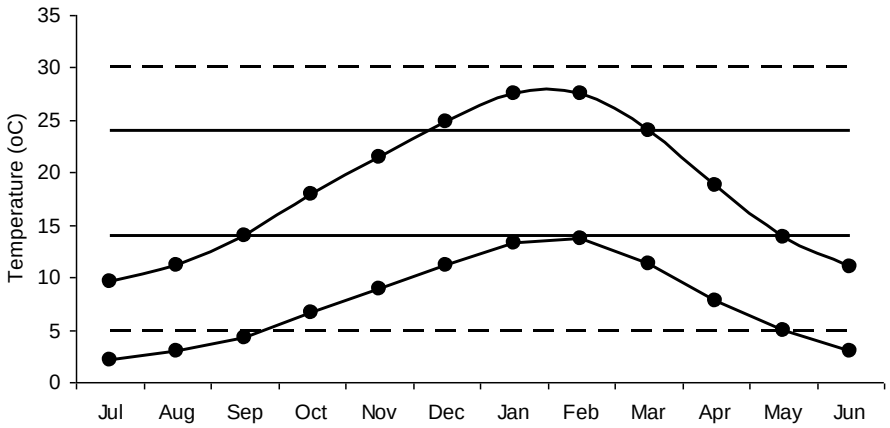
Lettuce



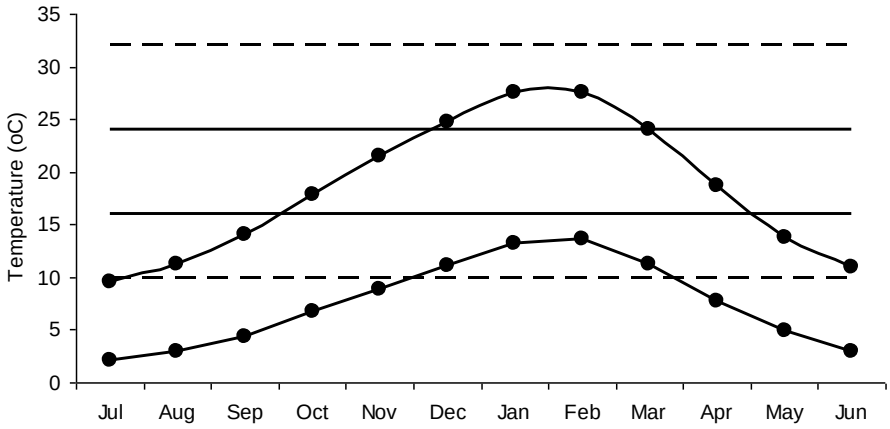
Beechworth

Lat. 36o 23' S Long. 146o 44' Elev. 580 m

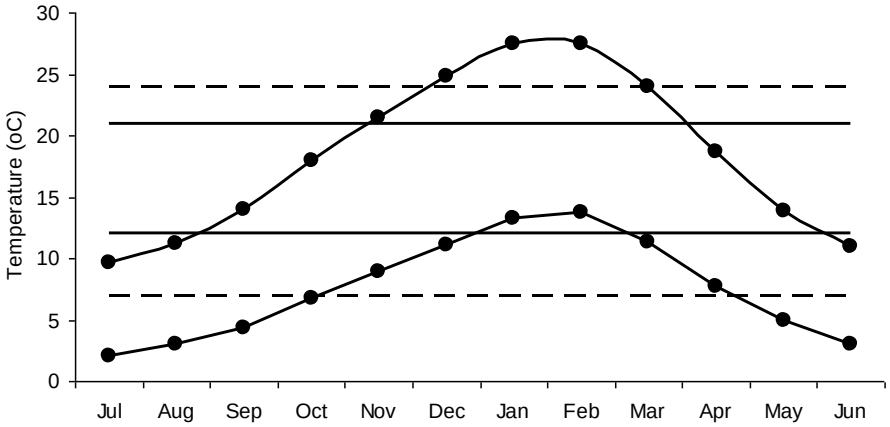
Spinach



European Wild Rocket



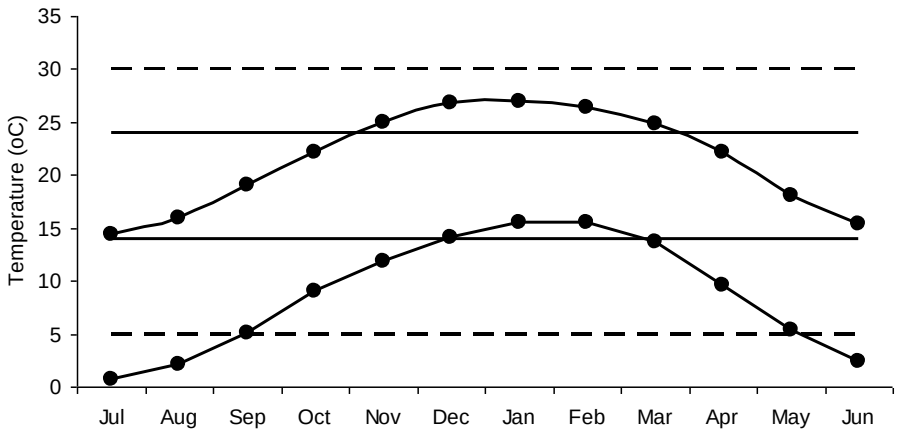
Lettuce



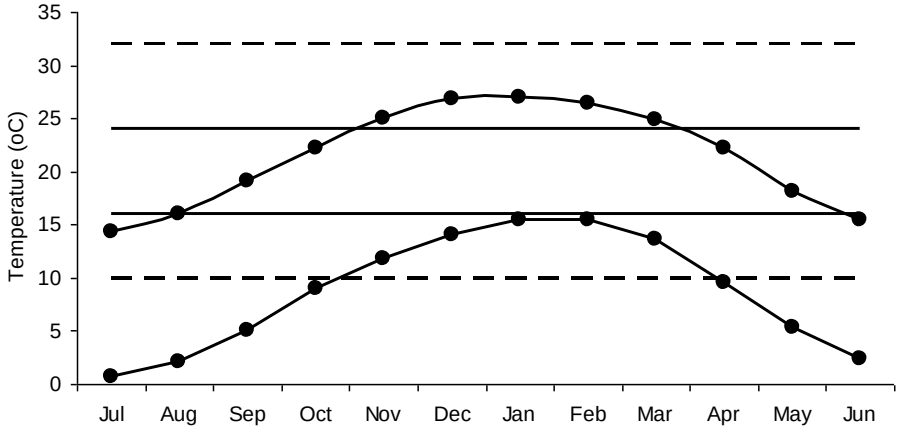
Stanthorpe

Lat. 28o39' S Long.151o56' E Elev. 792m

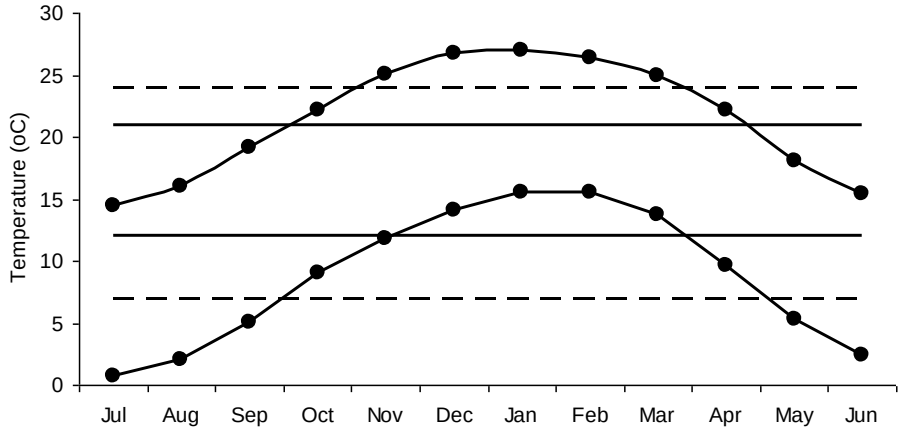
Spinach



European Wild Rocket



Lettuce

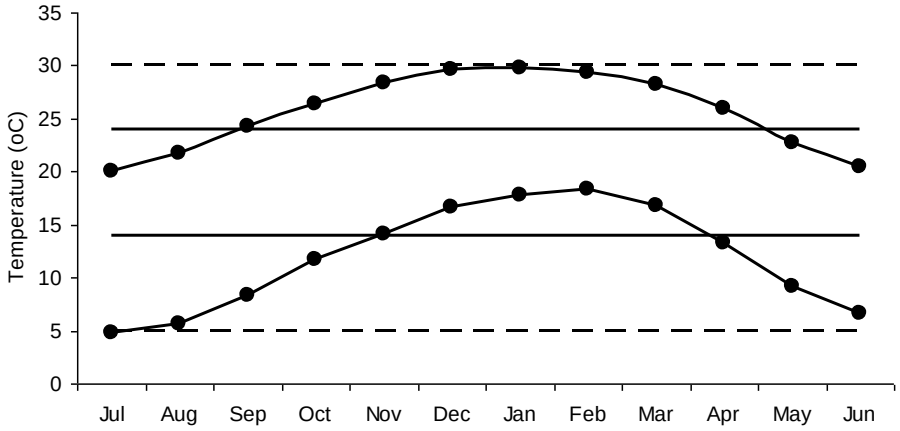


NSW

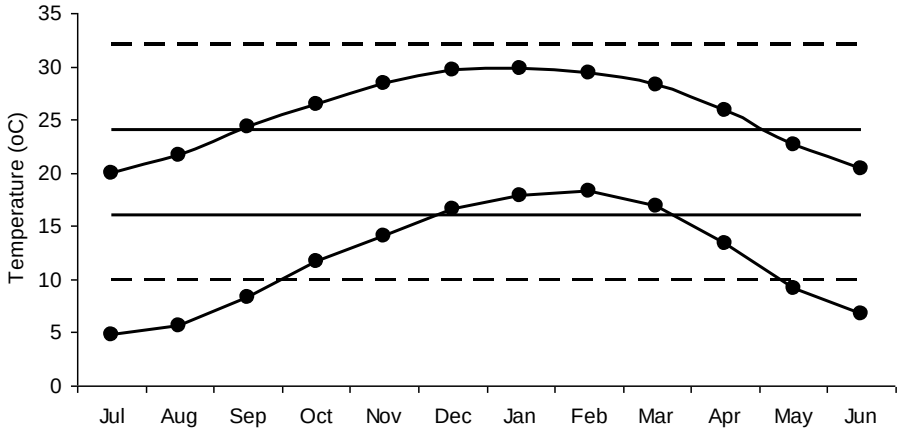
Bellingen

Elevation: 15 m

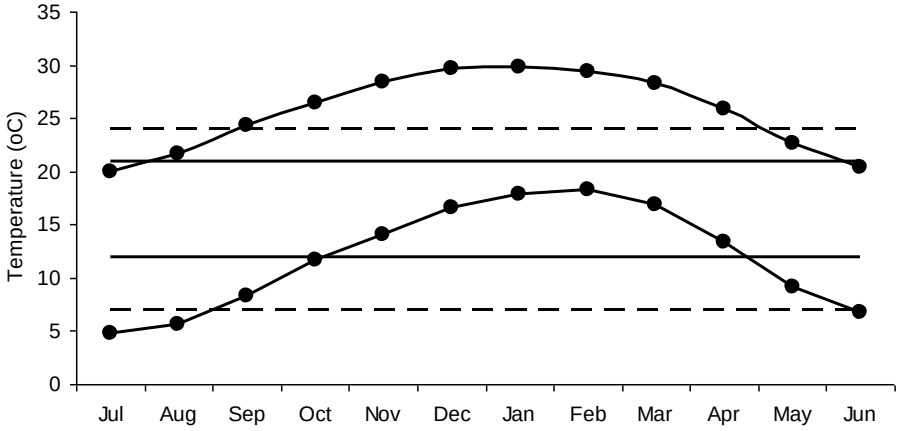
Spinach



European Wild Rocket



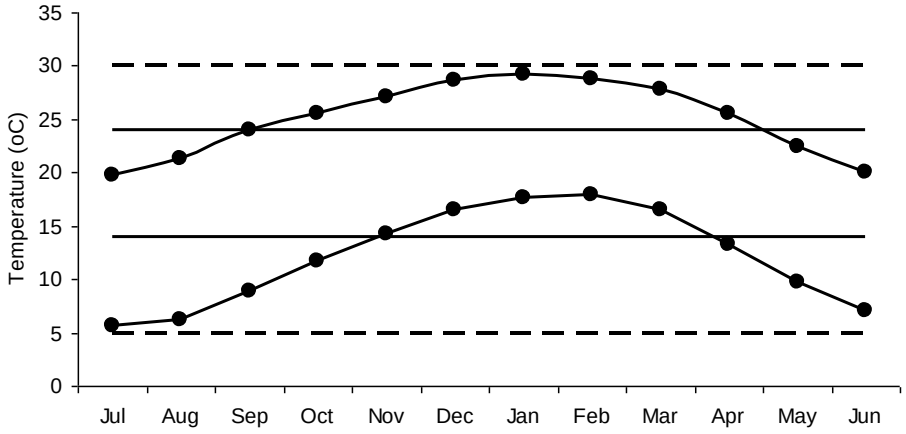
Lettuce



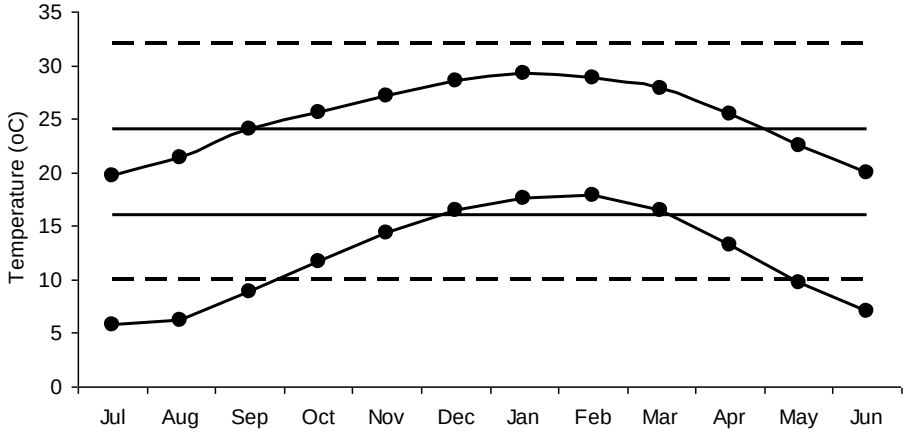
Kempsey

Elevation: 10 m

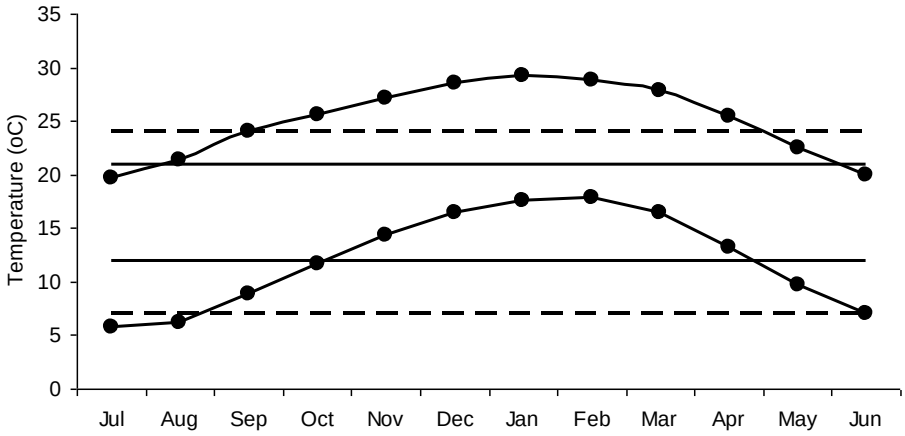
Spinach



European Wild Rocket



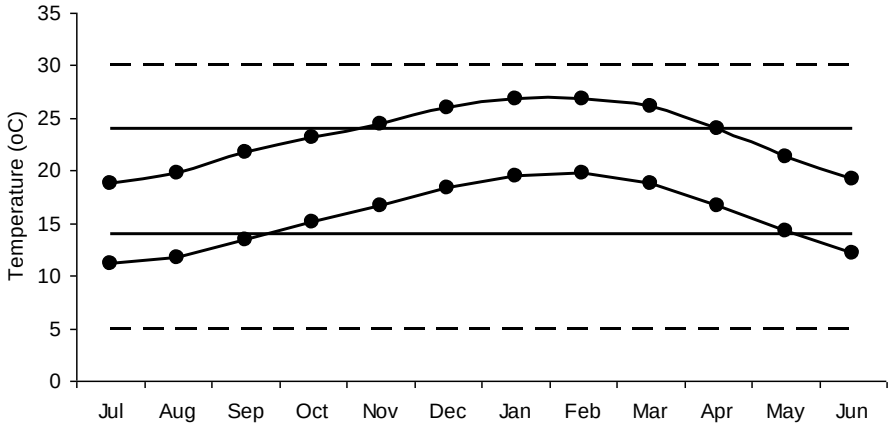
Lettuce



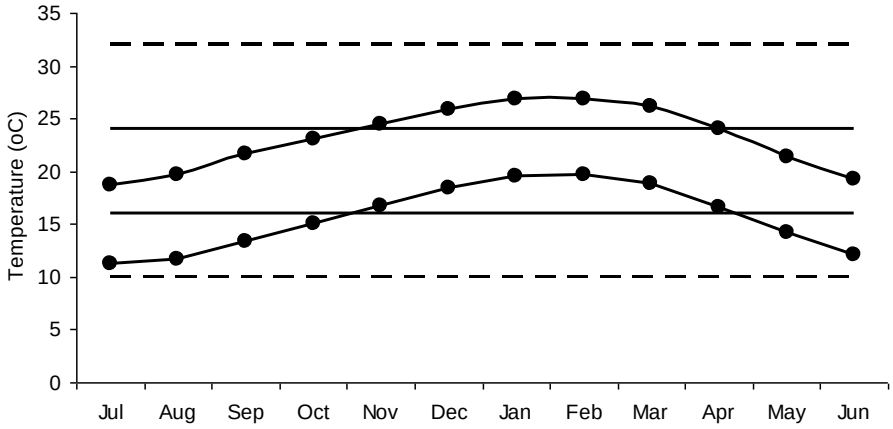
Southwest rocks (Stuarts Point)

Elevation: 117 m

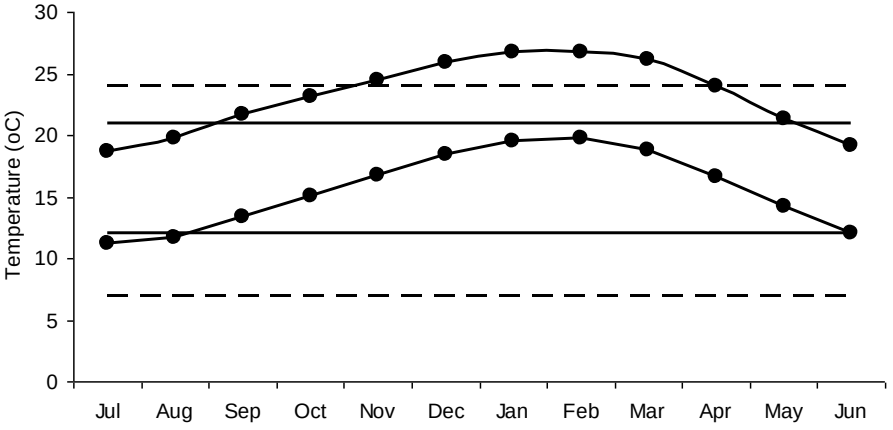
Spinach



European Wild Rocket



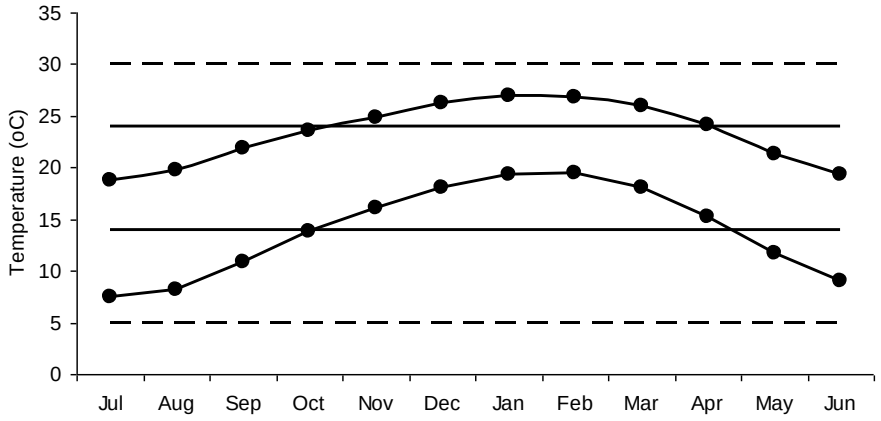
Lettuce



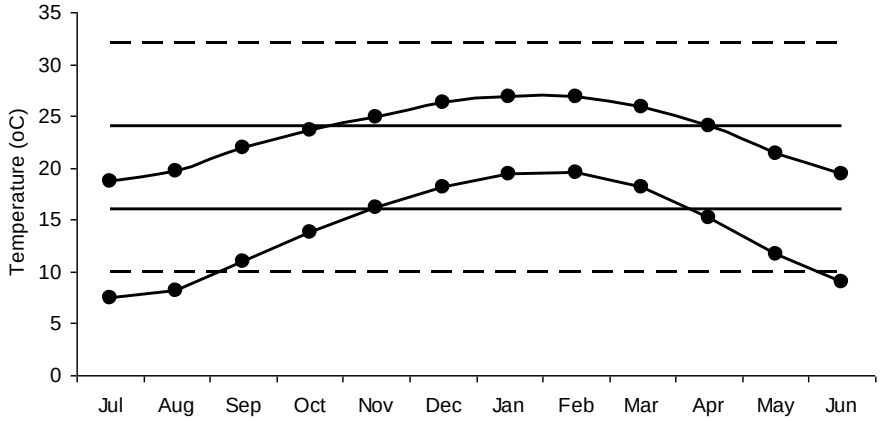
Coffs Harbour

Elevation: 5 m

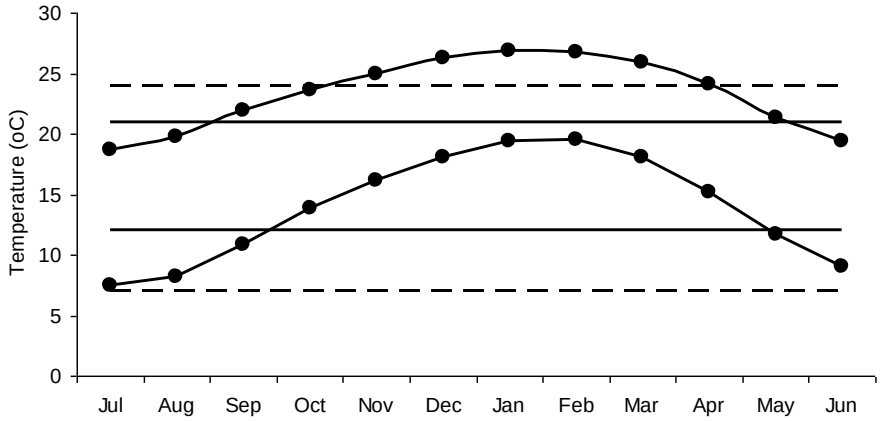
Spinach



European Wild Rocket



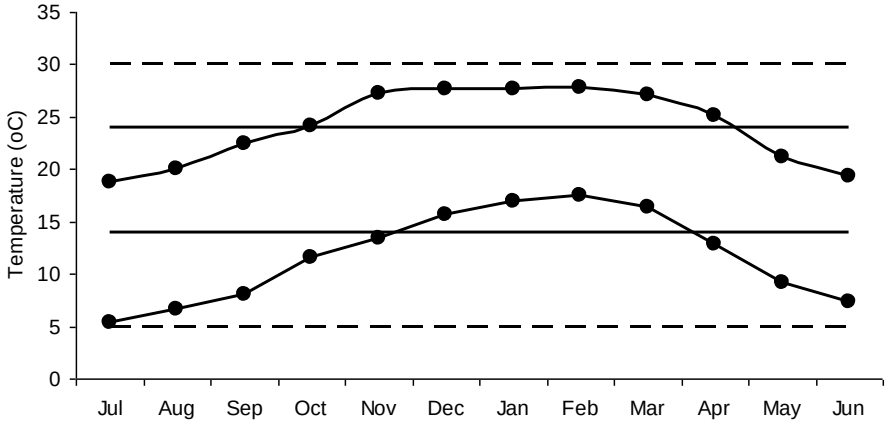
Lettuce



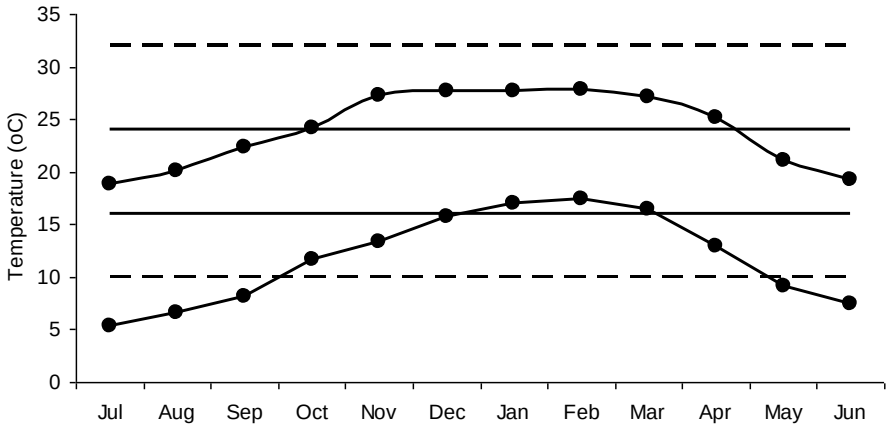
Waughope

Elevation: 9 m

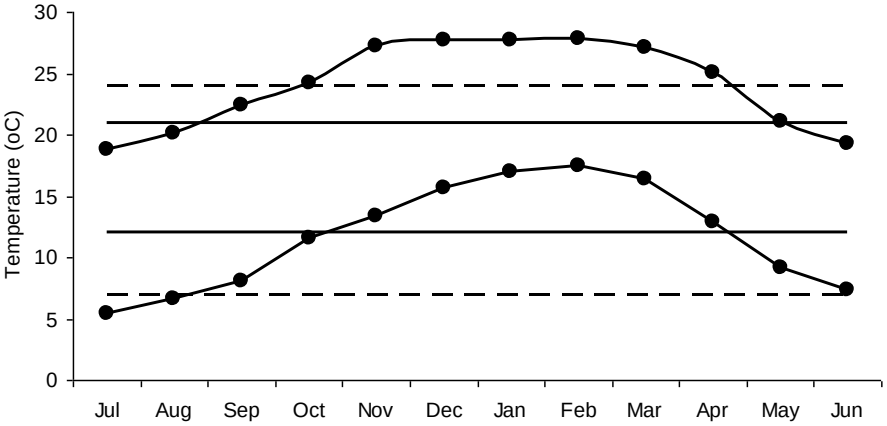
Spinach



European Wild Rocket



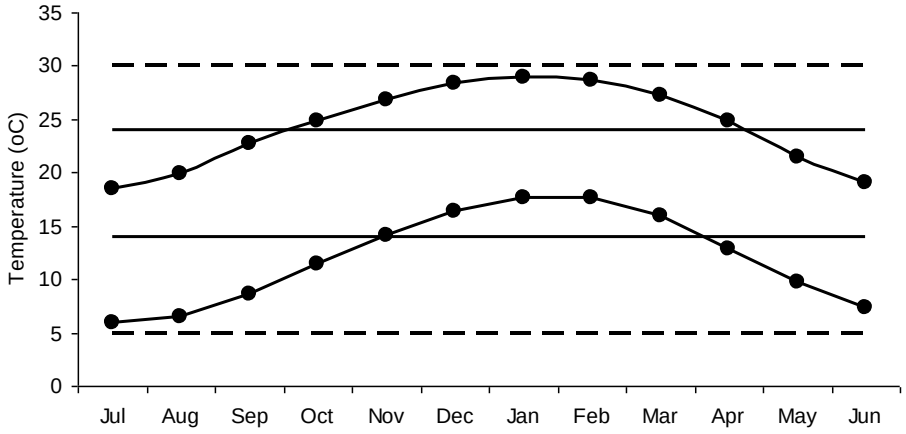
Lettuce



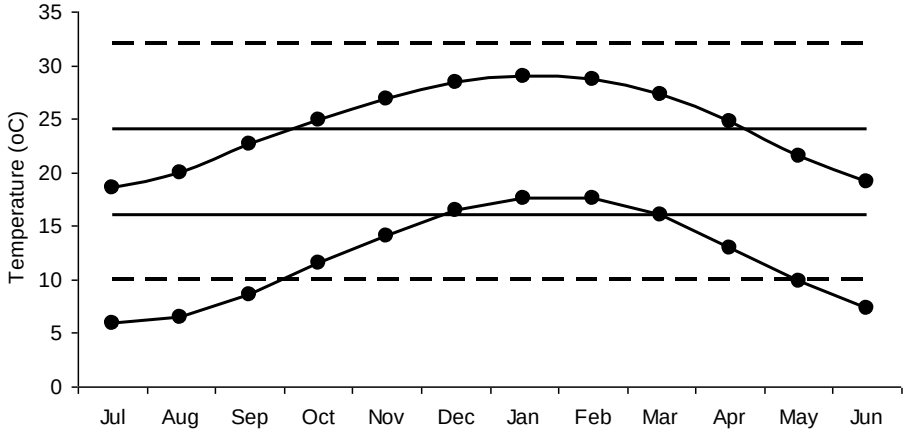
Taree

Elevation: 5 m

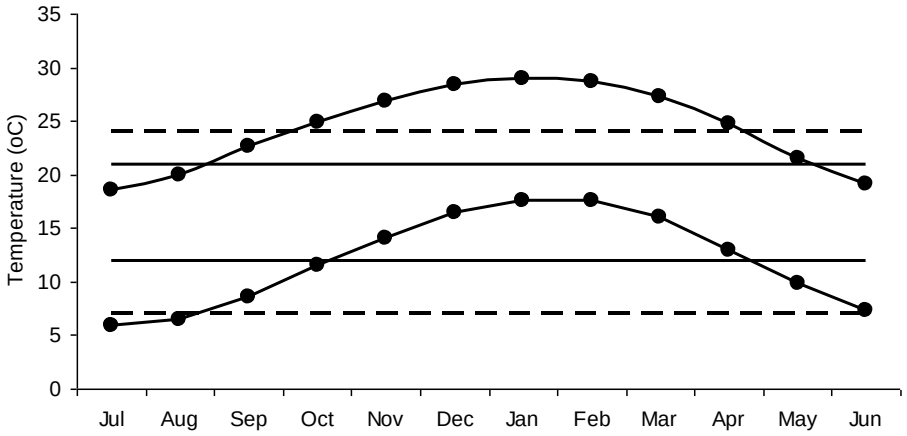
Spinach



European Wild Rocket



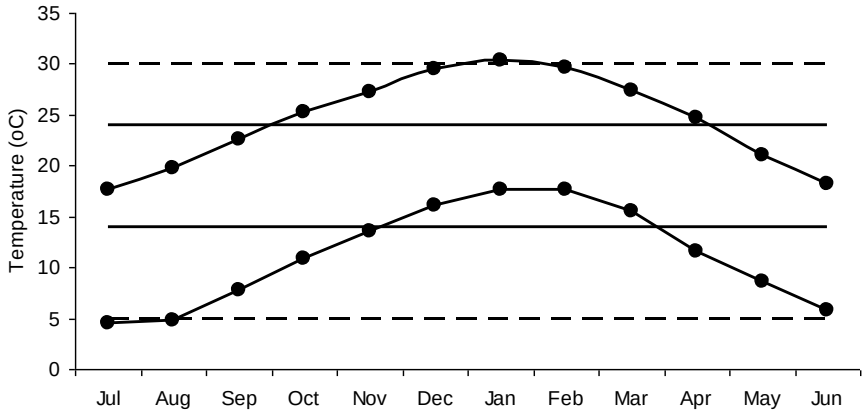
Lettuce



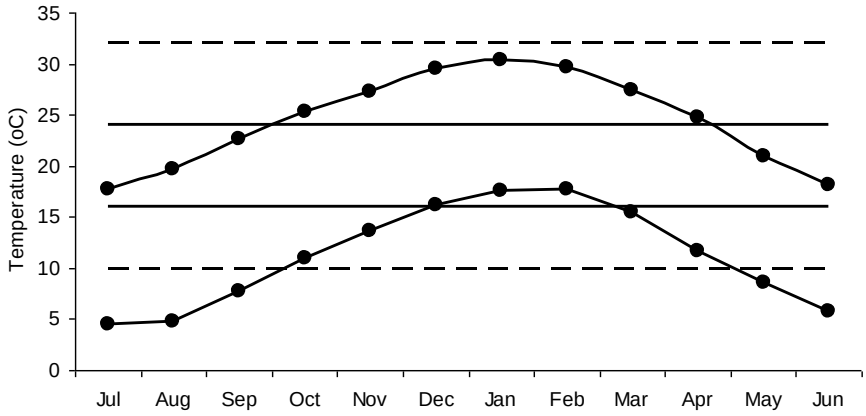
Cessnock

Elevation: 65 m

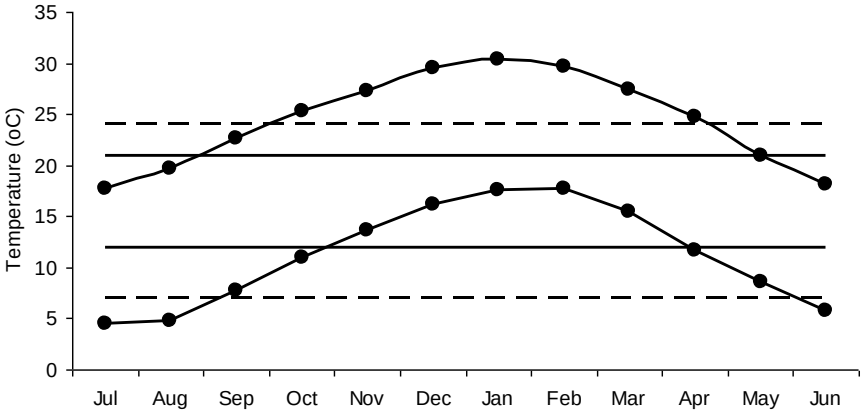
Spinach



European Wild Rocket



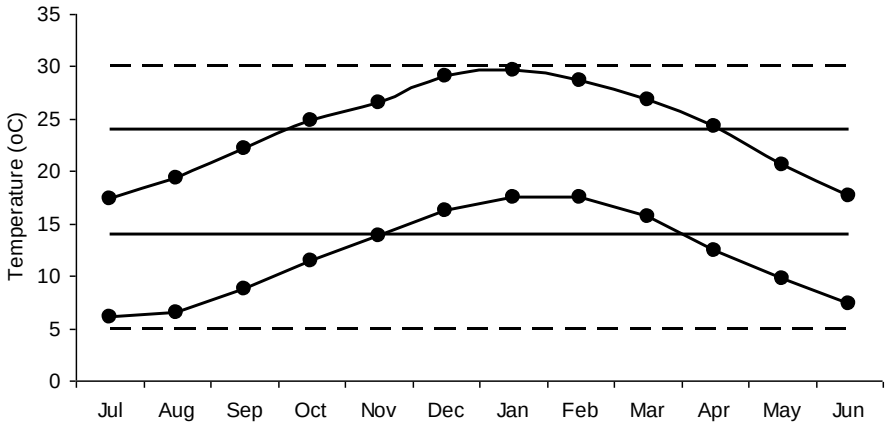
Lettuce



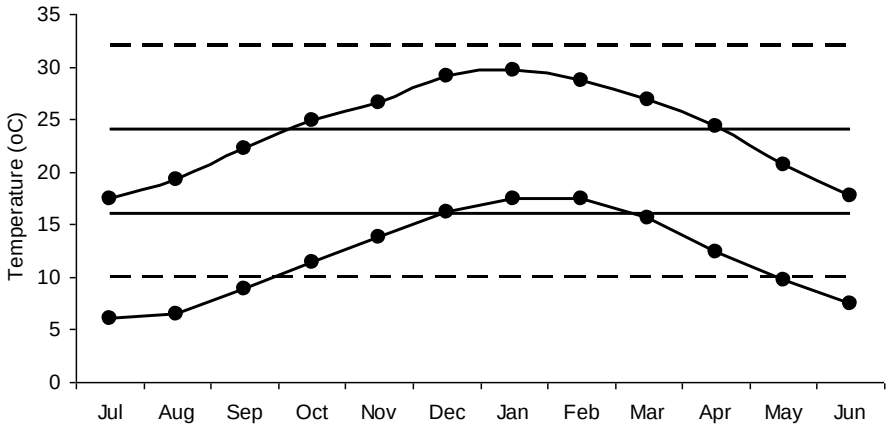
East Maitland (Tocal)

Elevation: 30 m

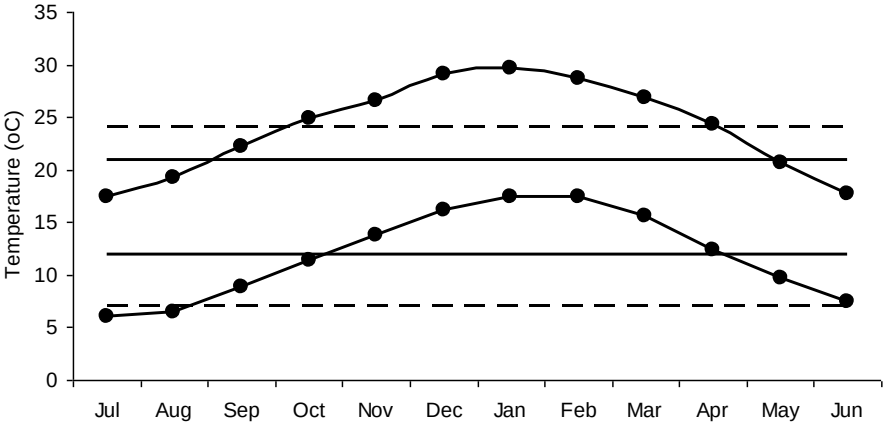
Spinach



European Wild Rocket



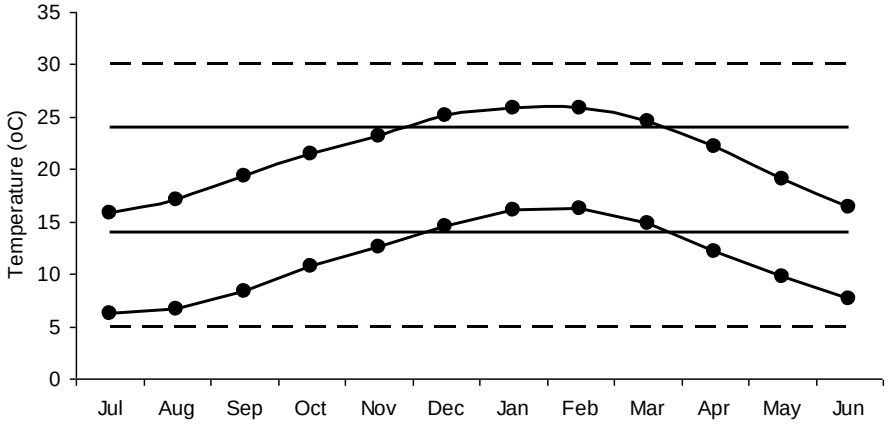
Lettuce



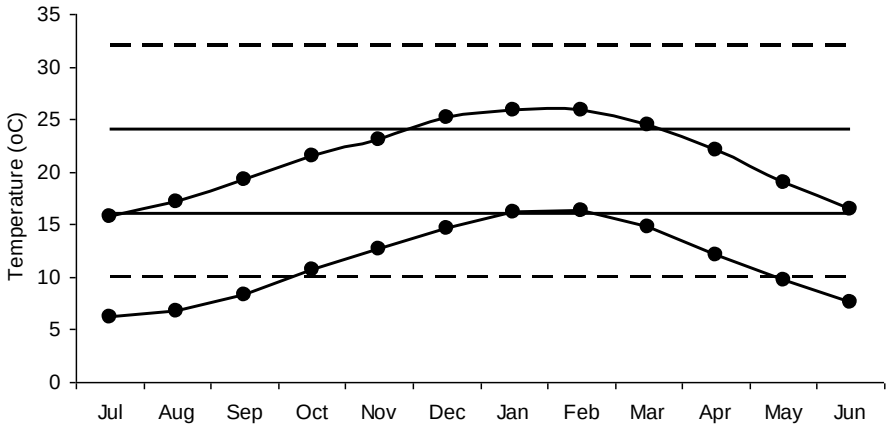
Nowra

Elevation: 109 m

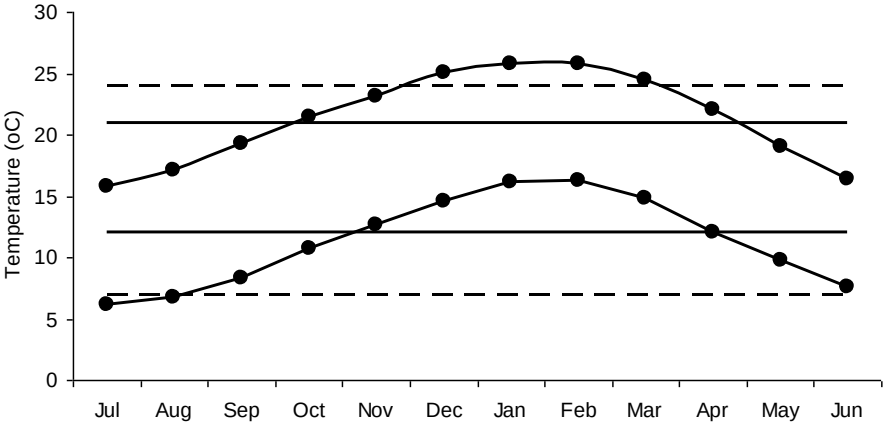
Spinach



European Wild Rocket



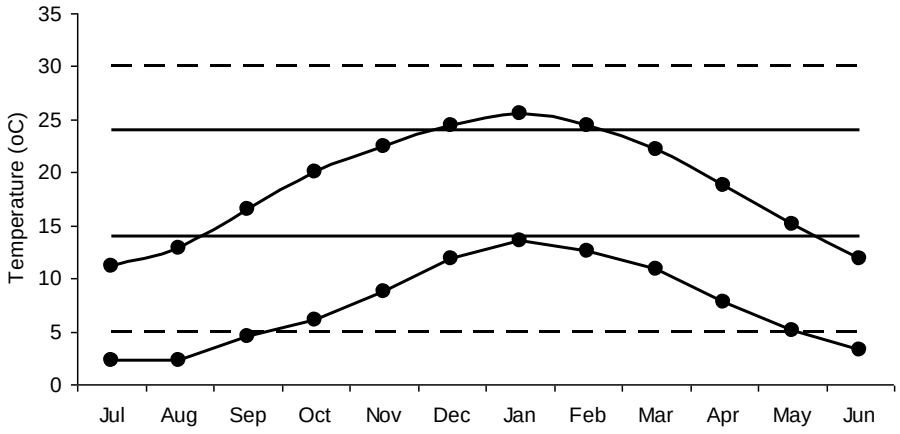
Lettuce



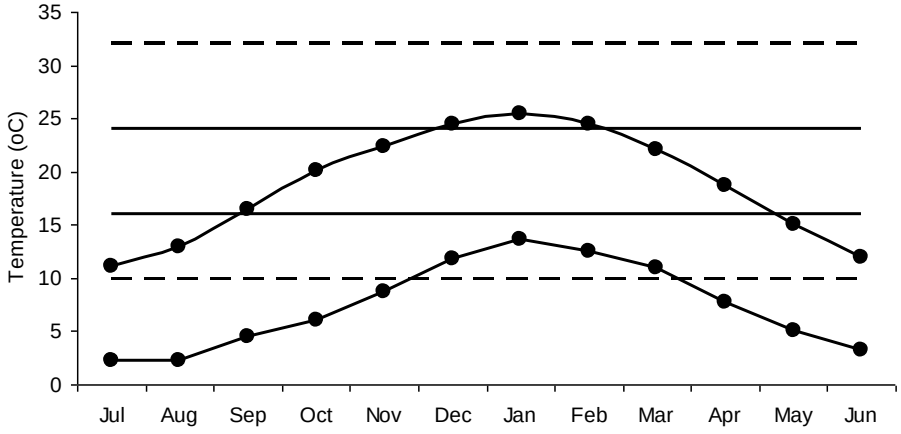
Robertson (Mittagong)

Elevation: 635 m

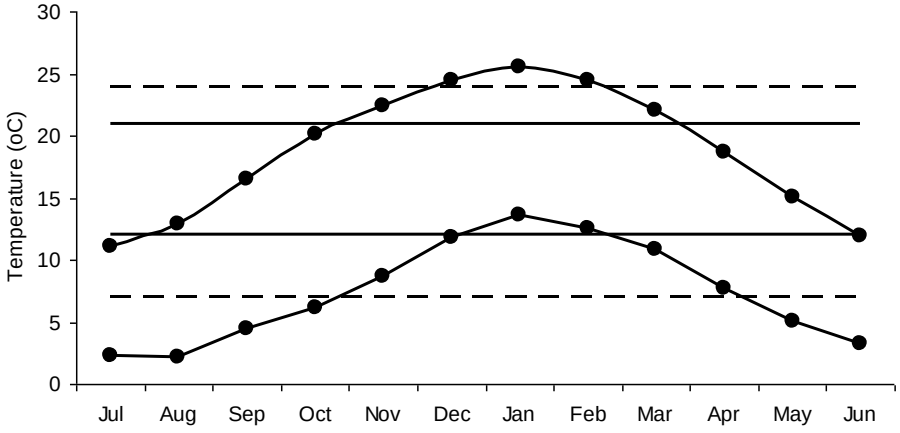
Spinach



European Wild Rocket



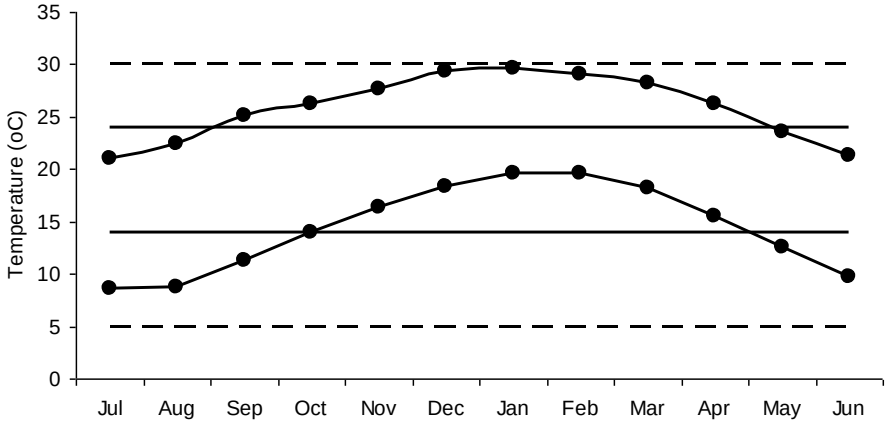
Lettuce



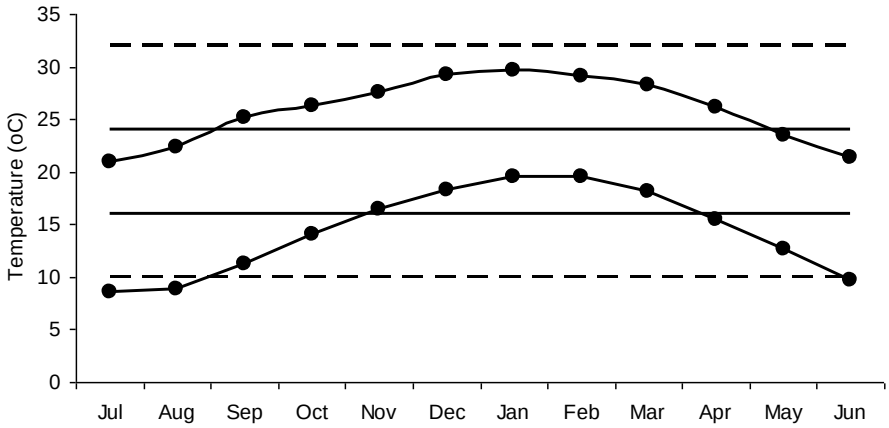
Murwillumbah

Elevation: 18 m

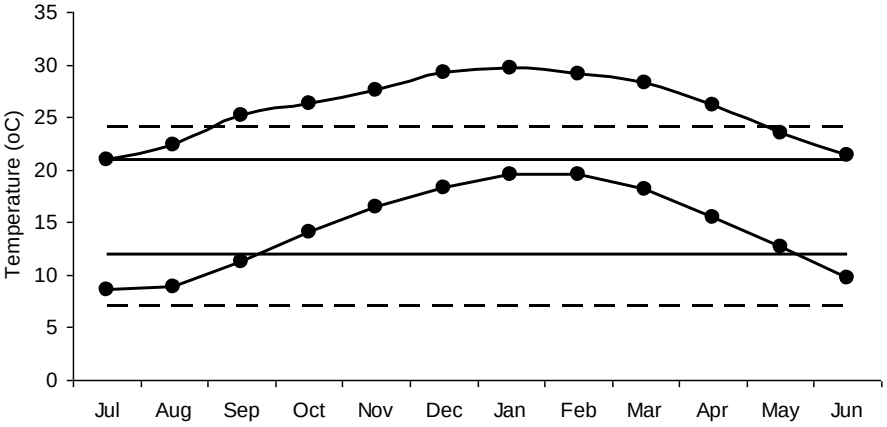
Spinach



European Wild Rocket



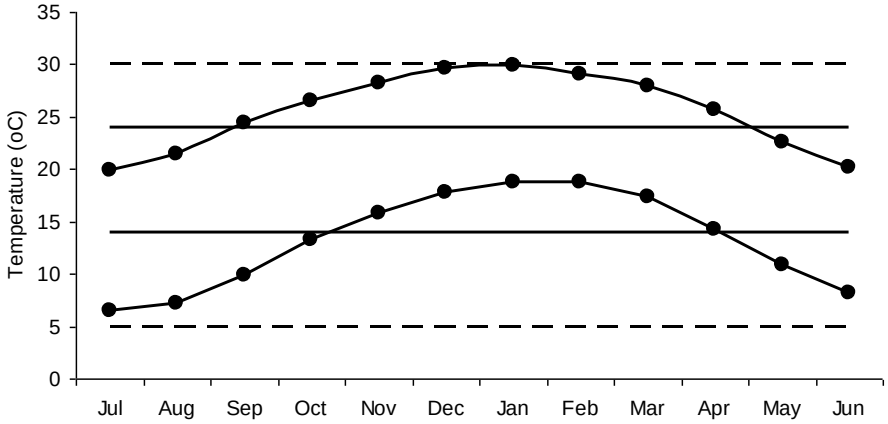
Lettuce



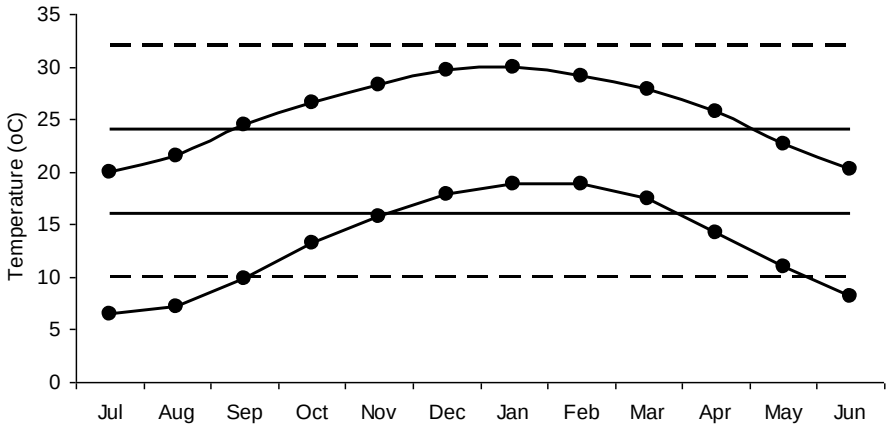
Lismore

Elevation: 11 m

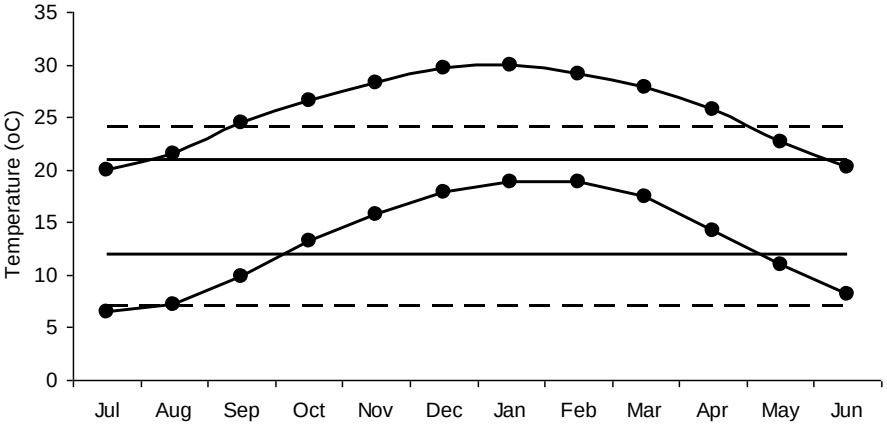
Spinach



European Wild Rocket



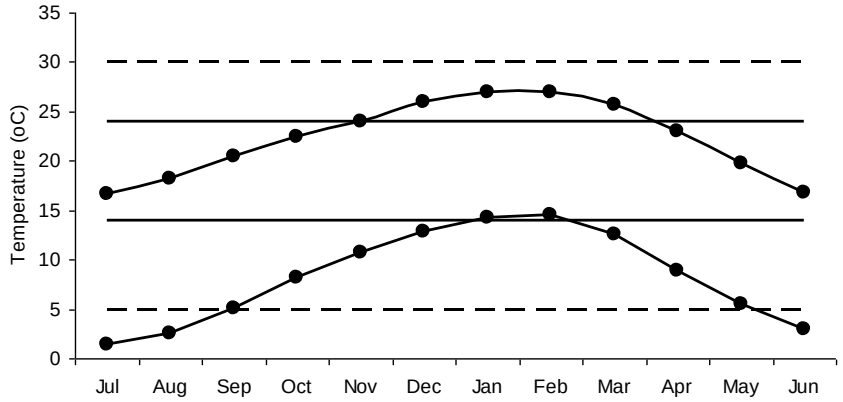
Lettuce



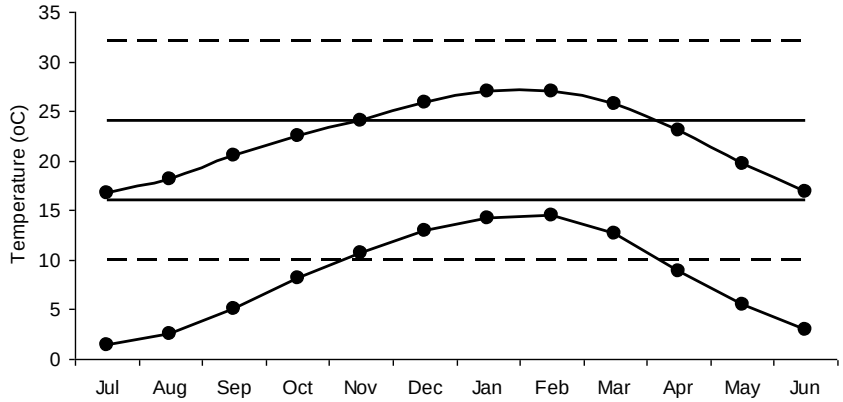
Bega

Elevation: 50 m

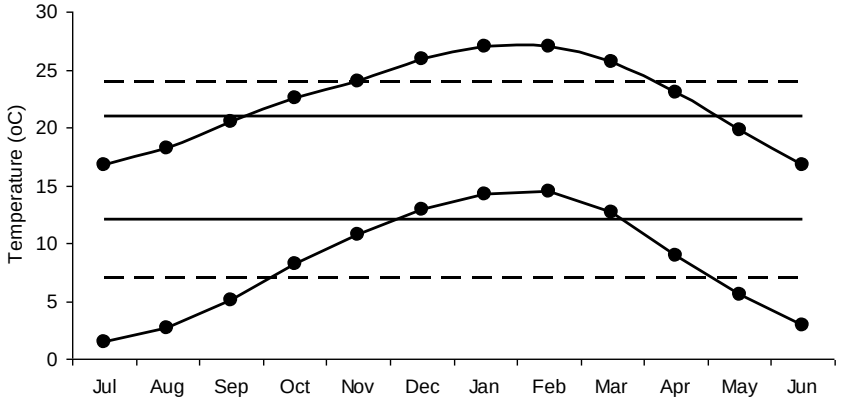
Spinach



European Wild Rocket



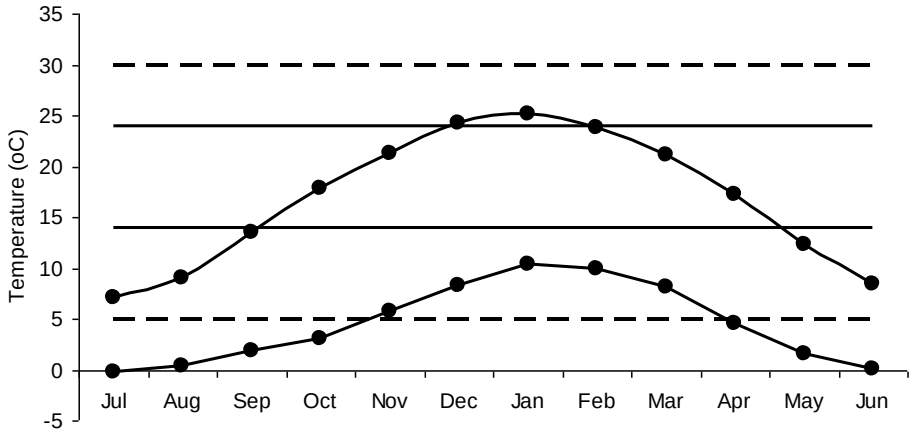
Lettuce



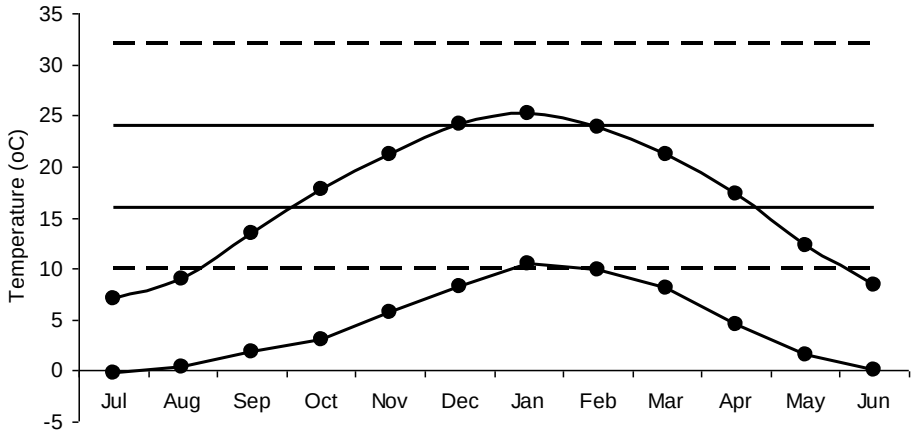
Sunny Corner, NSW

Latitude:-33.3947 S Longitude: 149.9013 E Elevation: 1220.0 m

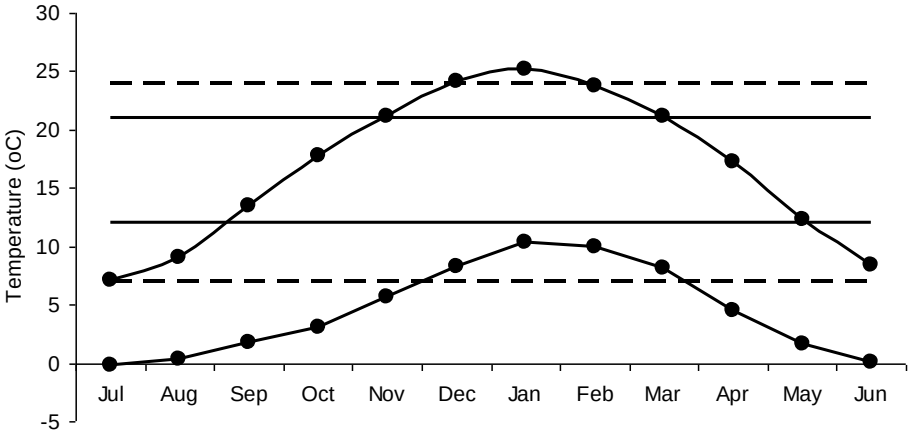
Spinach



European Wild Rocket



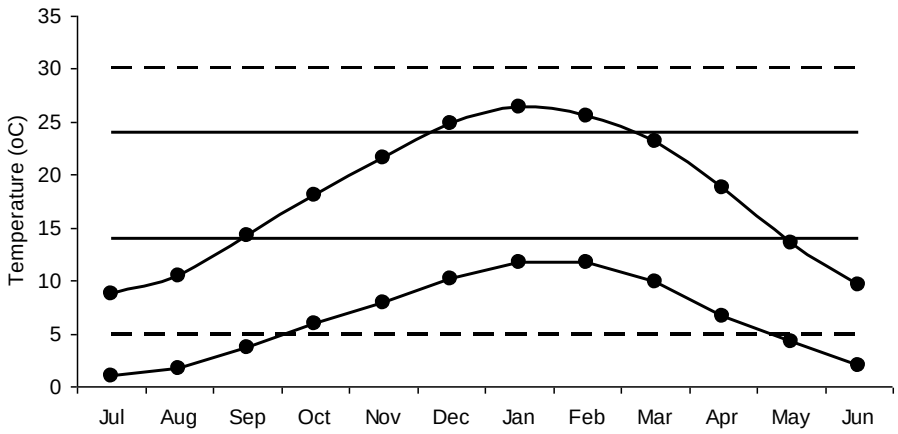
Lettuce



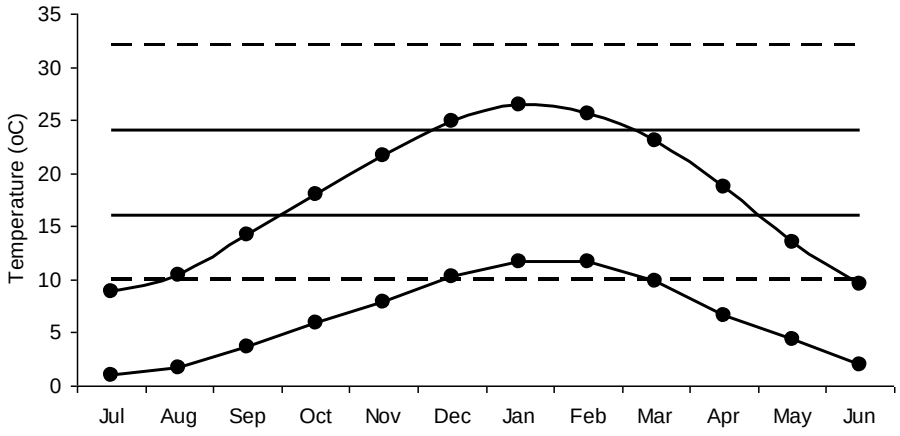
Milthorpe, NSW

Latitude:-33.4455 S Longitude: 149.1847 E Elevation: 960.0 m

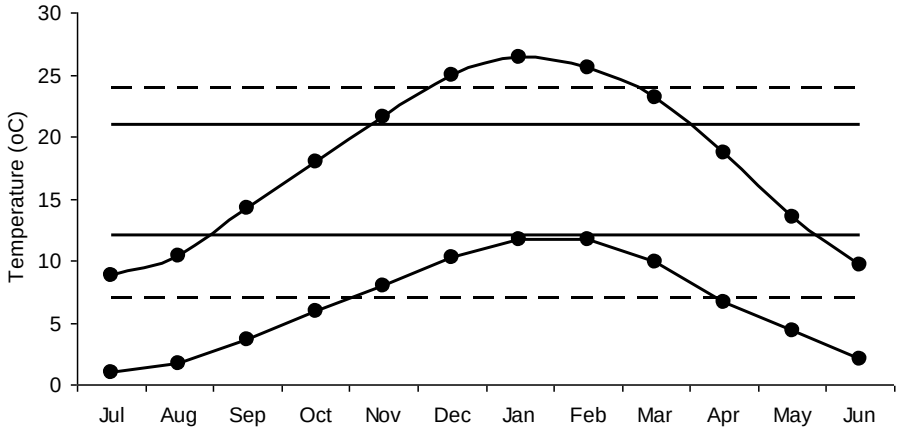
Spinach



European Wild Rocket



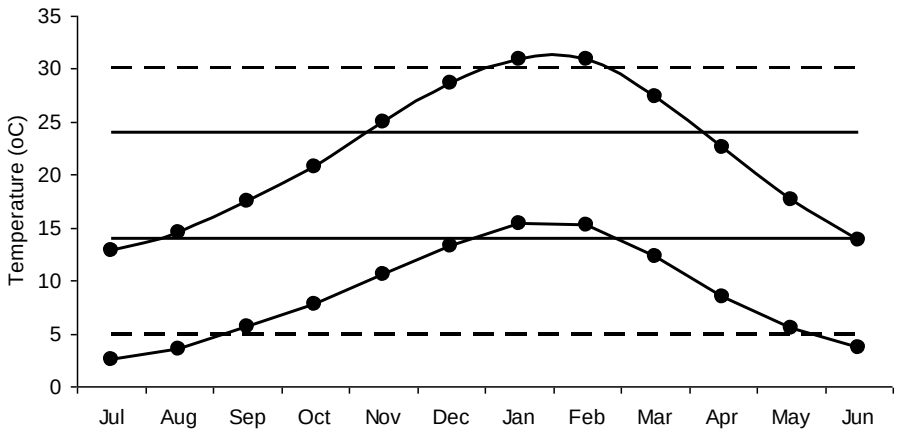
Lettuce



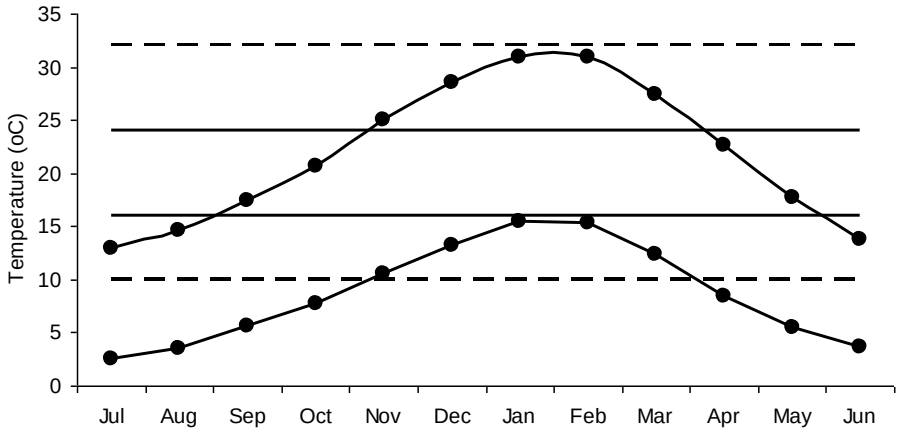
Albury

Latitude:-36.0705 S Longitude: 146.9550 E Elevation: 165.0 m

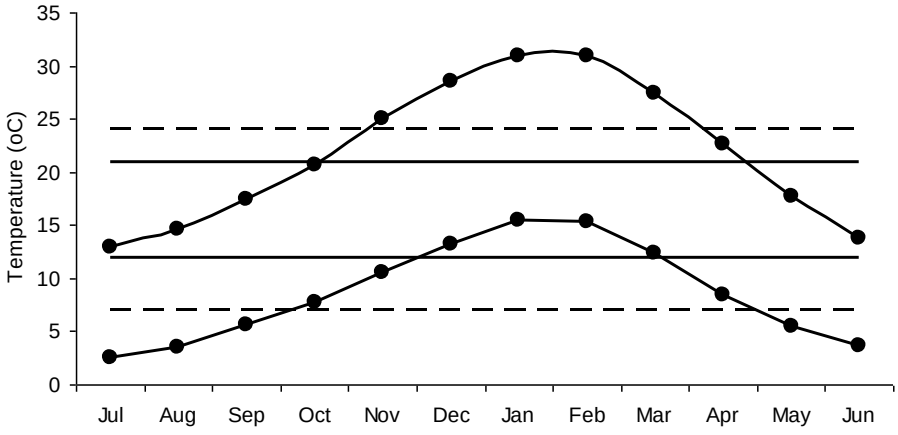
Spinach



European Wild Rocket



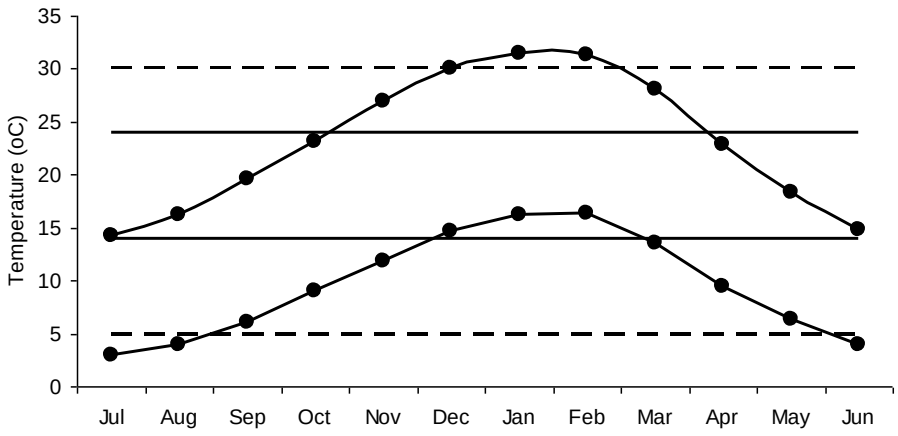
Lettuce



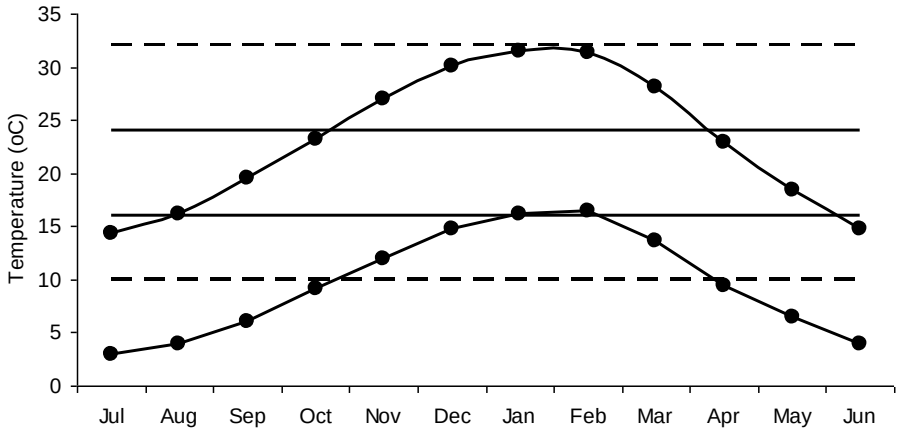
Griffith

Latitude:-34.3183 S Longitude: 146.0667 E Elevation: 126.0 m

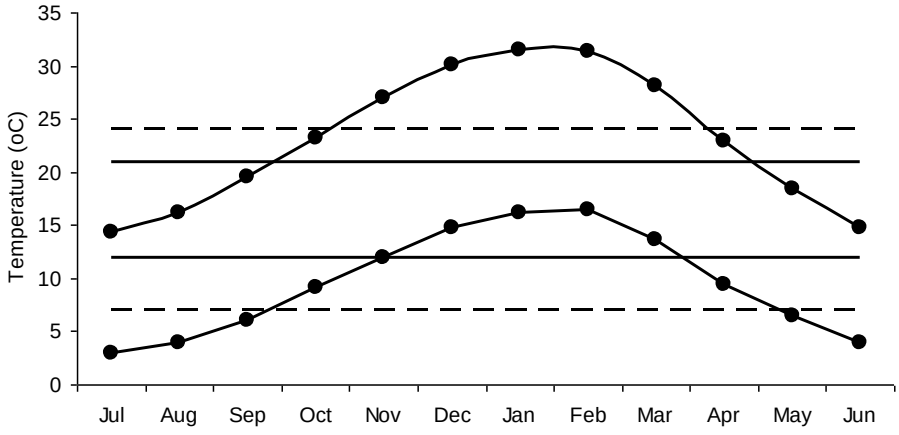
Spinach



European Wild Rocket



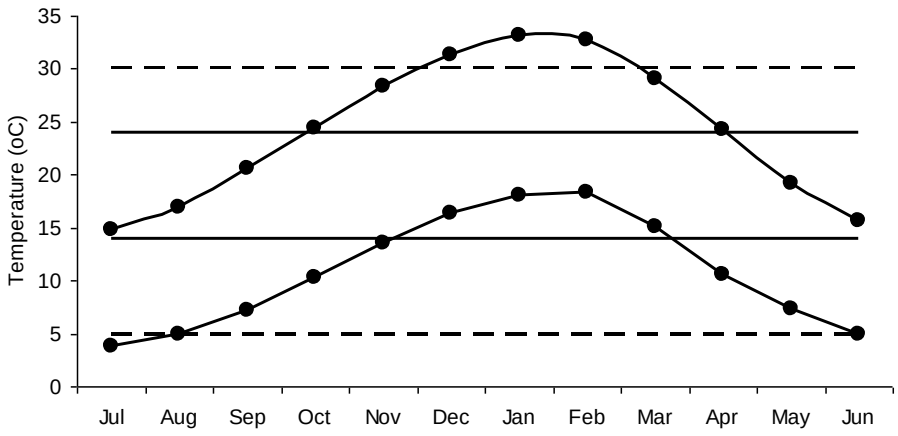
Lettuce



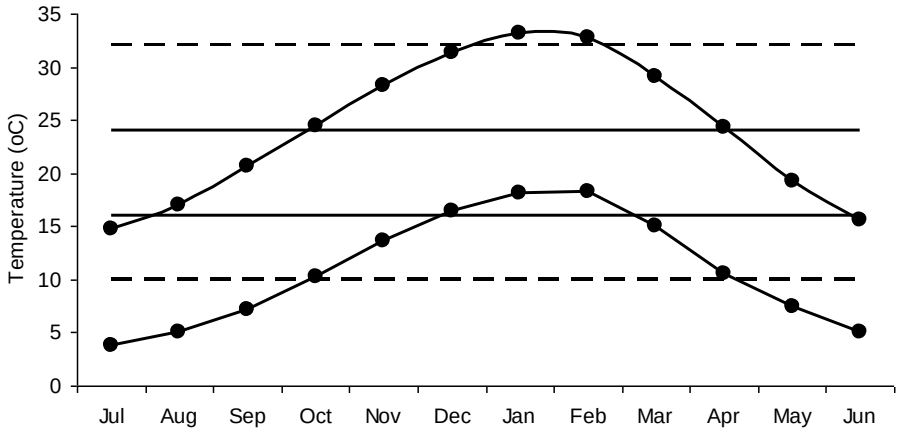
Hillstone

Latitude:-33.4915 S Longitude: 145.5249 E Elevation: 122.0 m

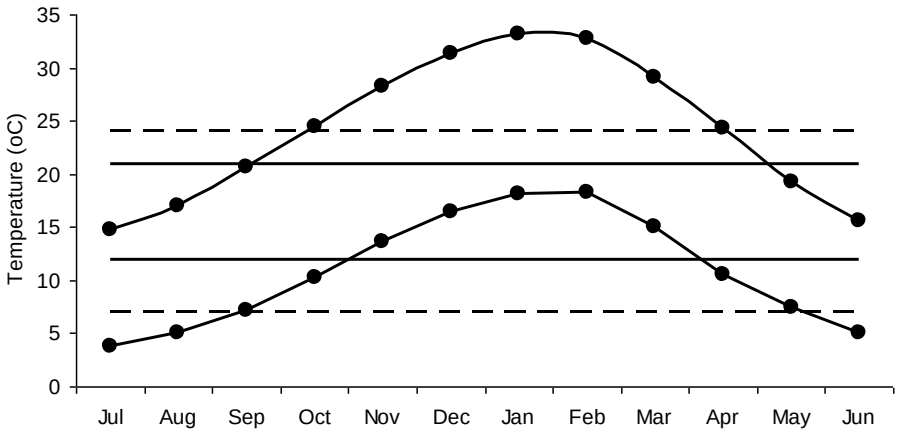
Spinach



European Wild Rocket



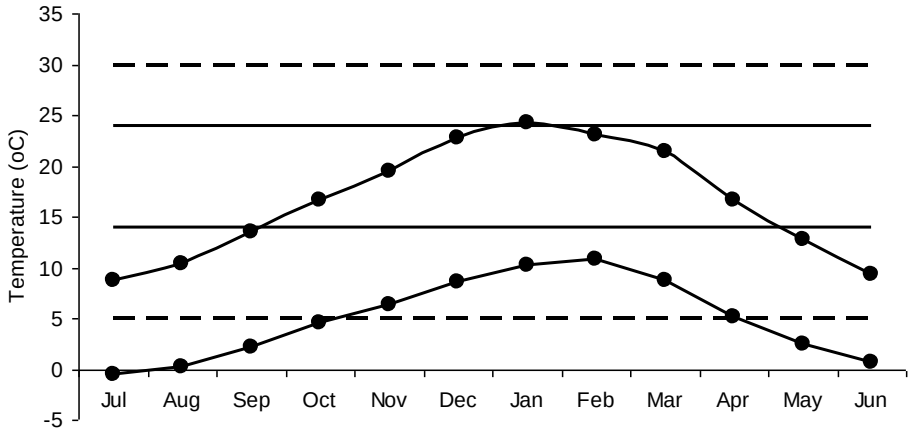
Lettuce



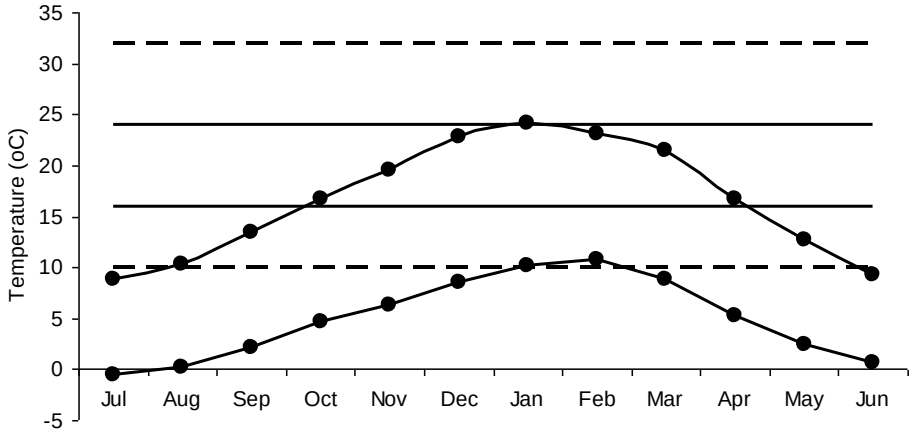
Oberon

Latitude:-33.7167 S Longitude: 149.8667 E Elevation: 1085.0 m

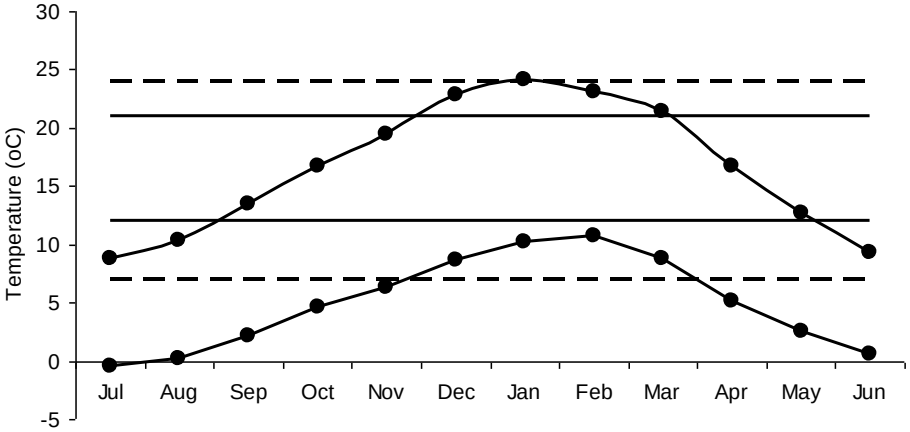
Spinach



European Wild Rocket



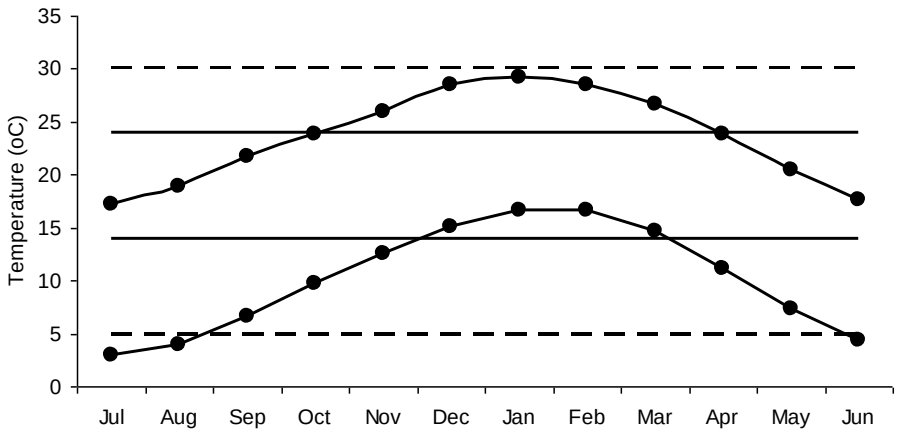
Lettuce



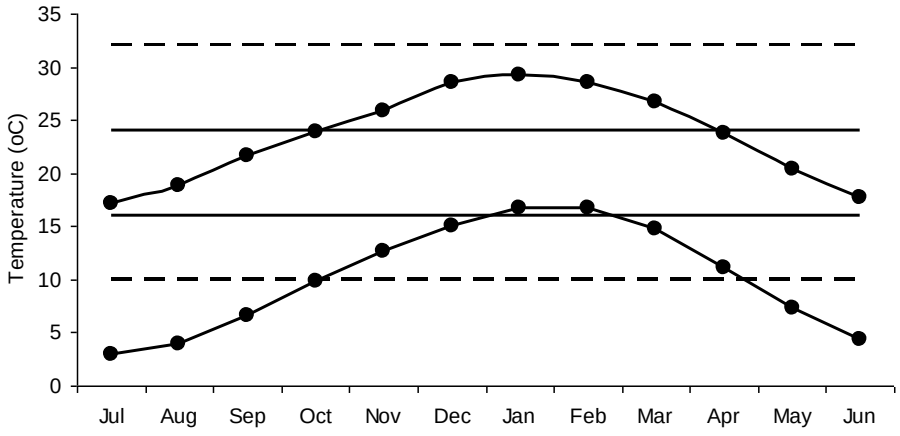
Camden

Latitude:-34.0391 S Longitude: 150.6890 E Elevation: 73.9 m

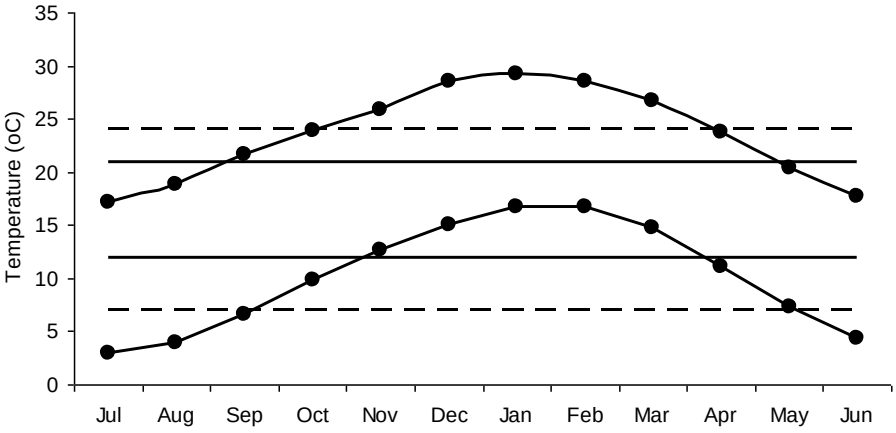
Spinach



European Wild Rocket



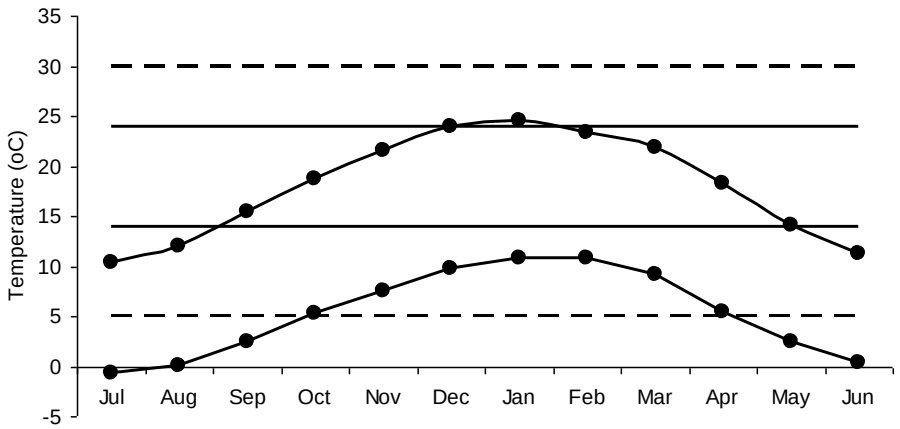
Lettuce



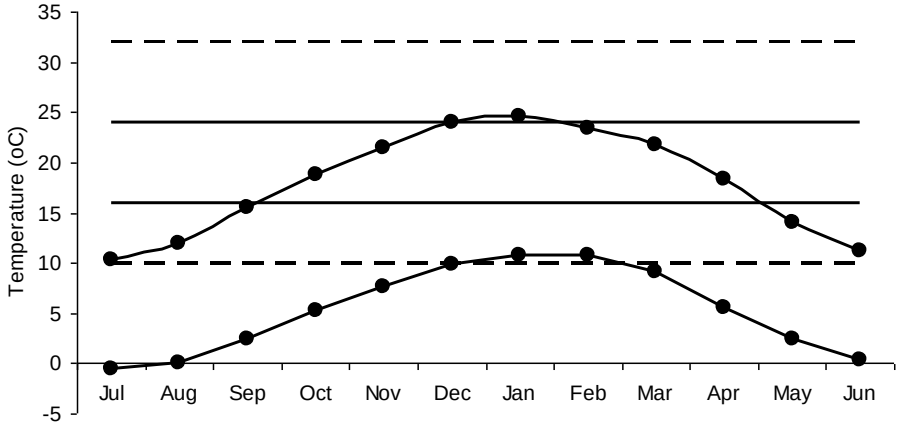
Guyra

Latitude:-30.2204 S Longitude: 151.6714 E Elevation: 1325.0 m

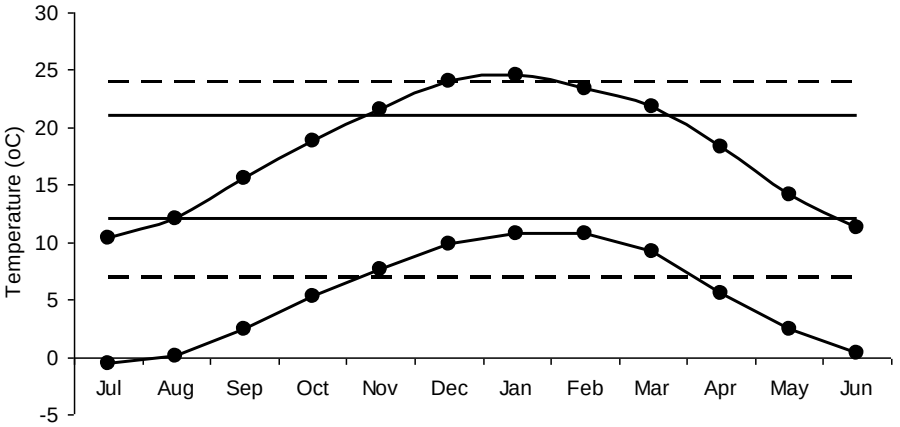
Spinach



European Wild Rocket



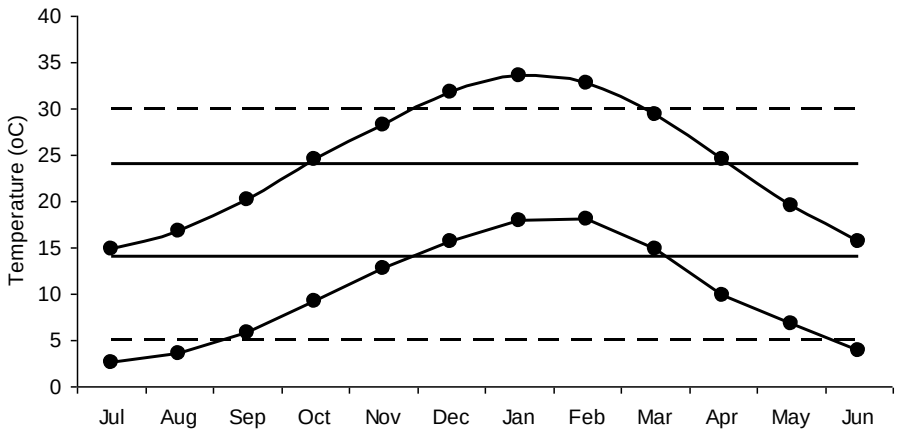
Lettuce



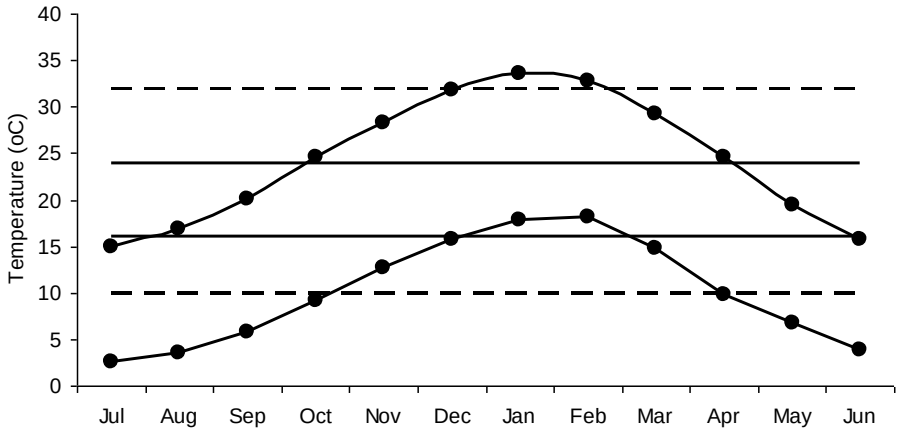
Condobolin

Latitude:-33.0664 S Longitude: 147.2283 E Elevation: 195.0 m

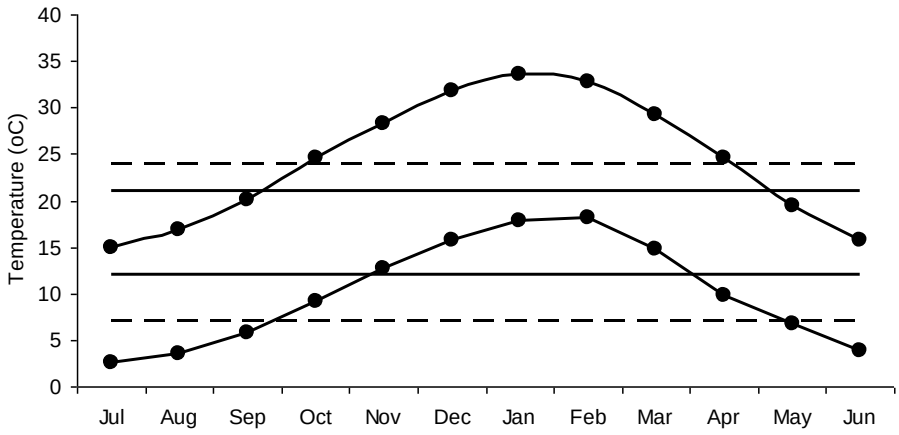
Spinach



European Wild Rocket



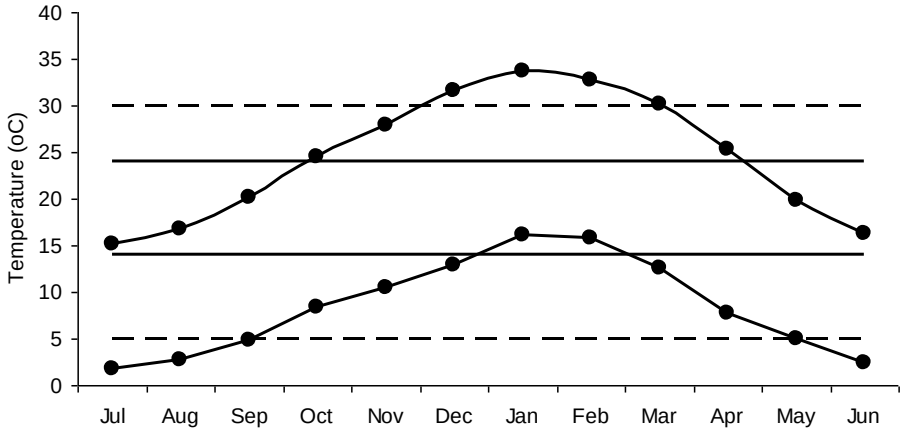
Lettuce



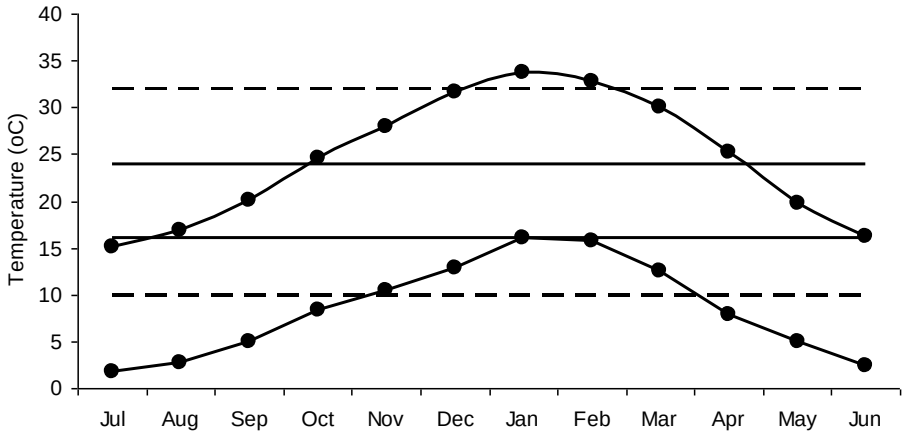
Canowindra

Lat. 33 o 34' S Long. 148 o 40' Elev. 300 m

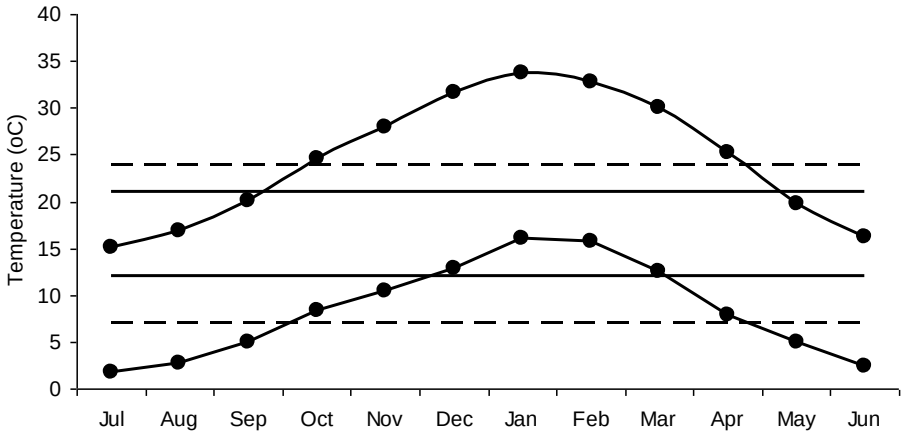
Spinach



European Wild Rocket



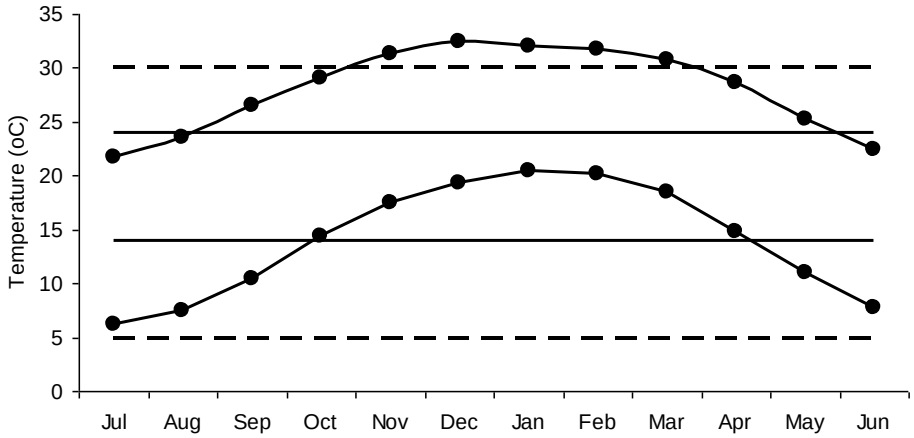
Lettuce



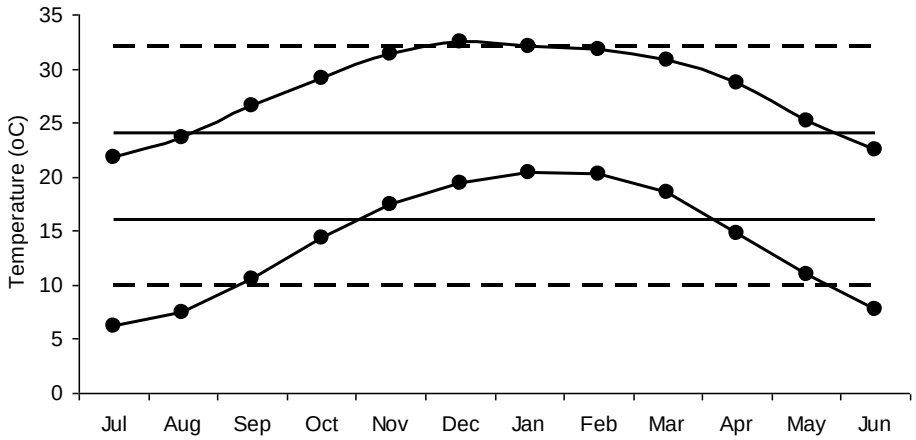
Gayndah

Lat. 25o38' S Long. 151o37' Elev. 106 m

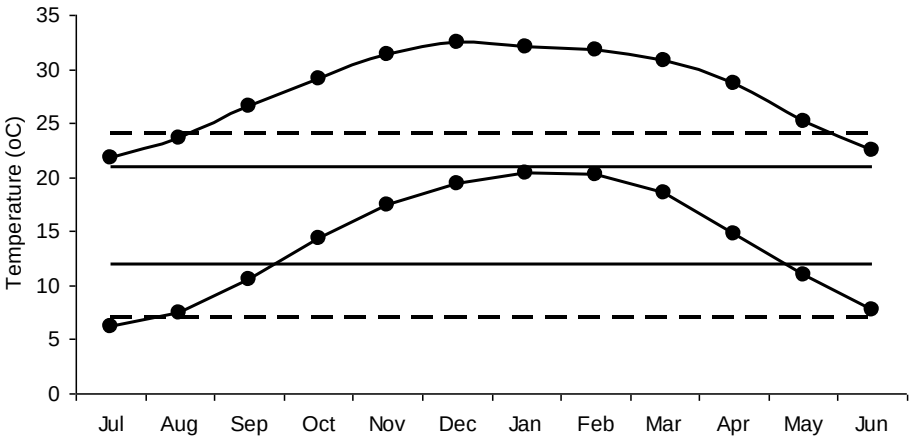
Spinach



European Wild Rocket



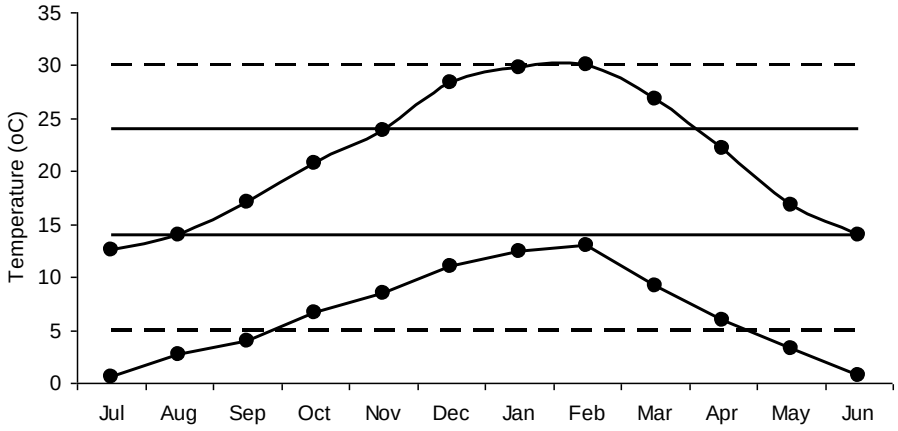
Lettuce



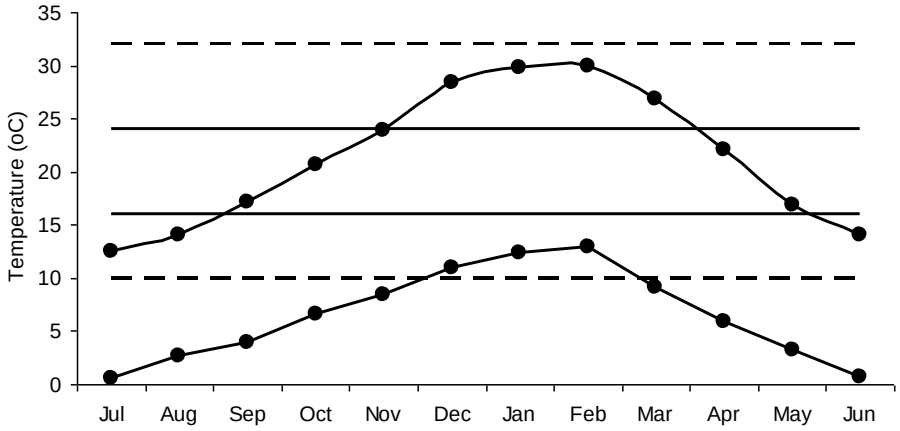
Tumut

Lat. 35o20' S Long.148o16' E Elev. 305 m

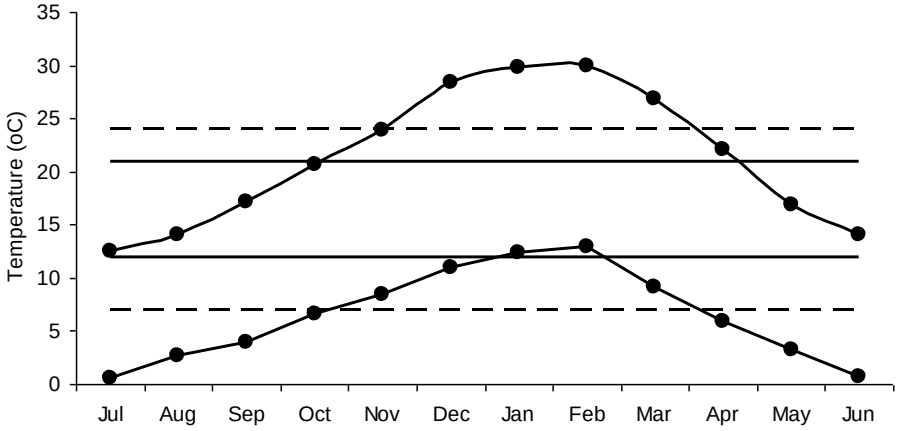
Spinach



European Wild Rocket



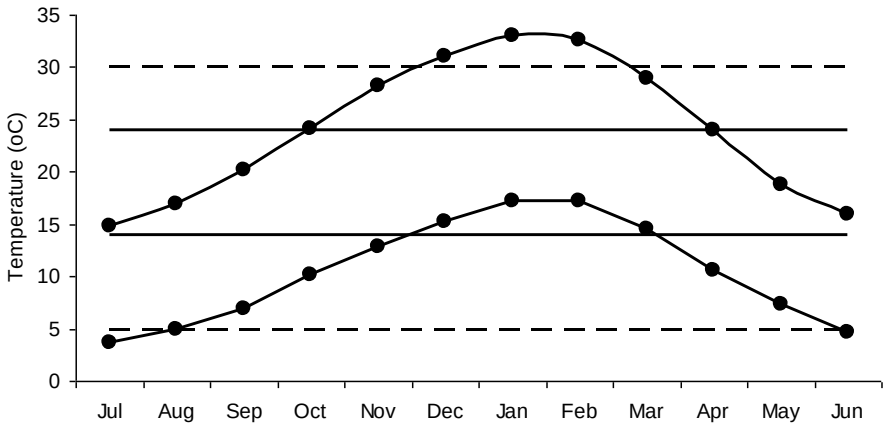
Lettuce



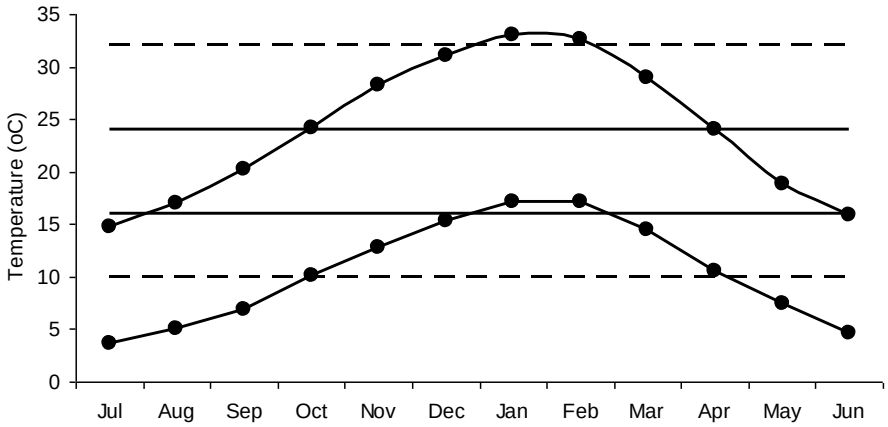
Hay

Lat. 34o19' S Long.146o4' E Elev. 126m

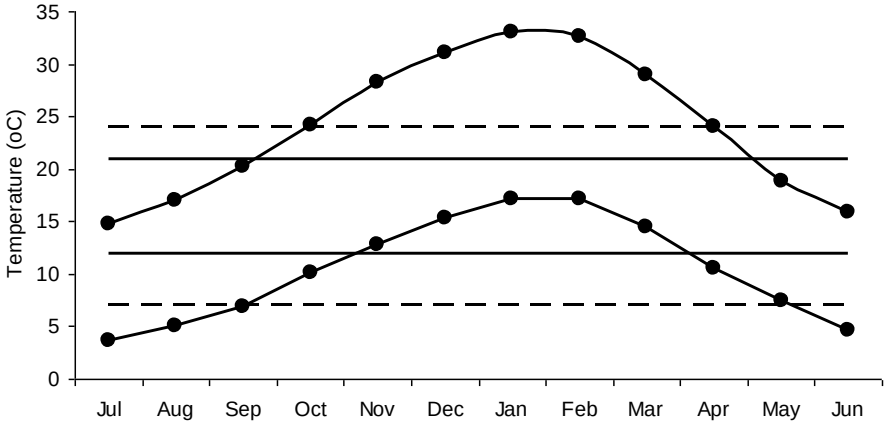
Spinach



European Wild Rocket



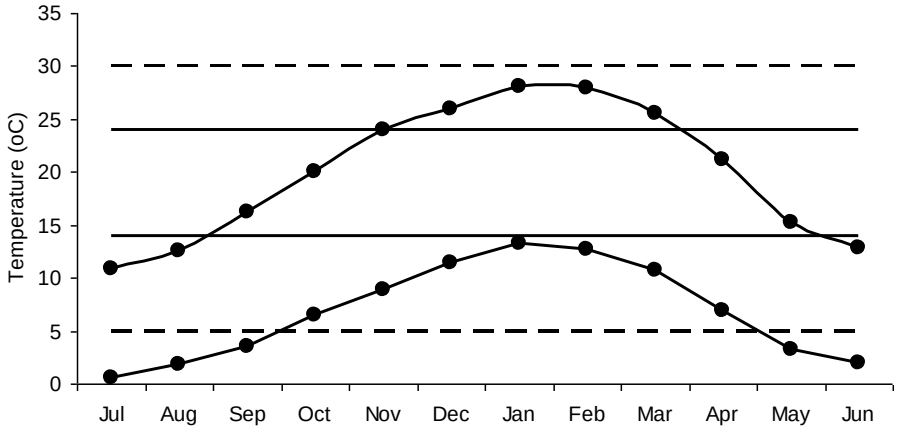
Lettuce



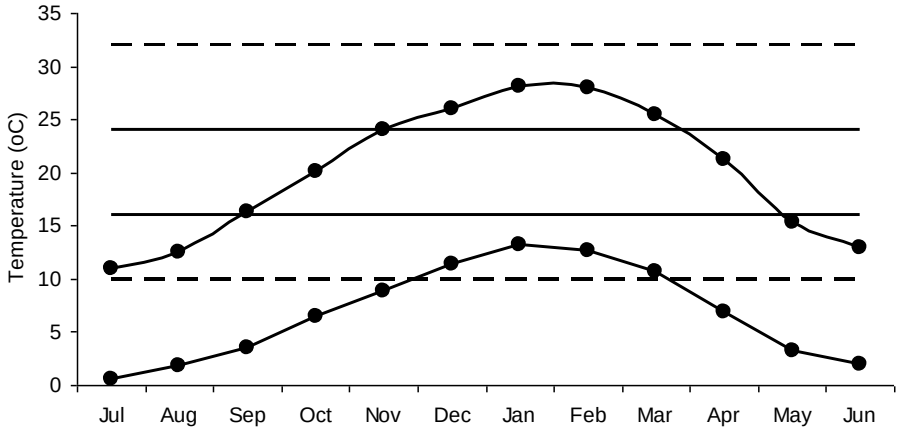
Orange

Lat. 33o25' S Long. 149o51' Elev. 863 m

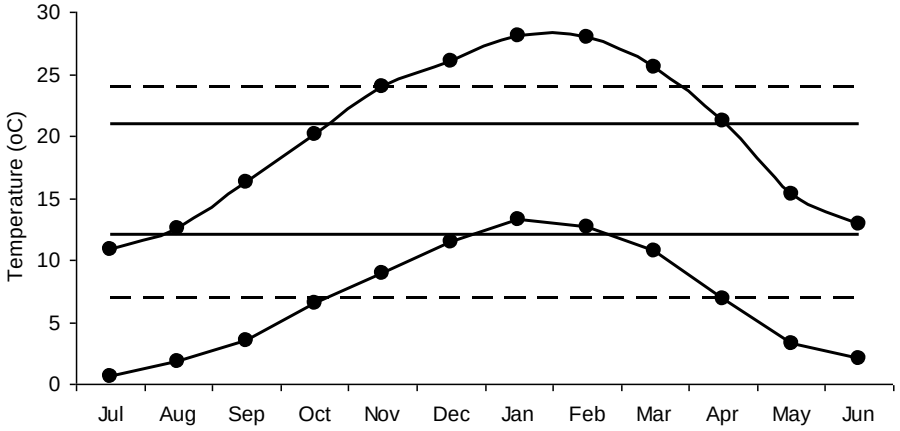
Spinach



European Wild Rocket



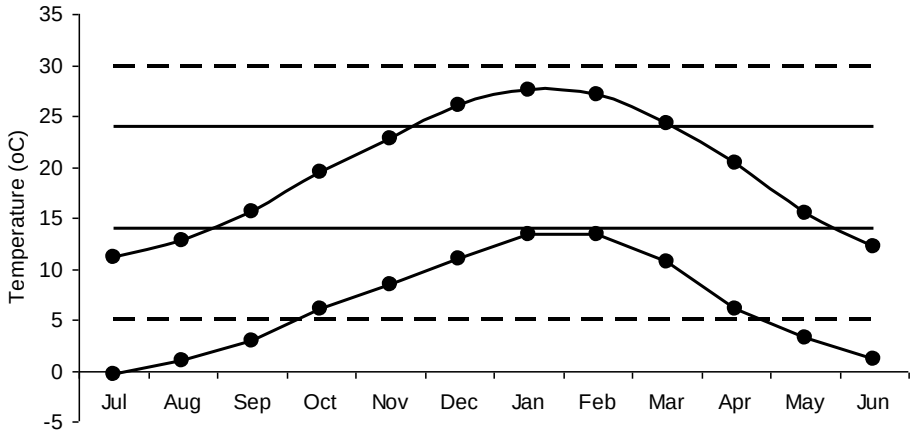
Lettuce



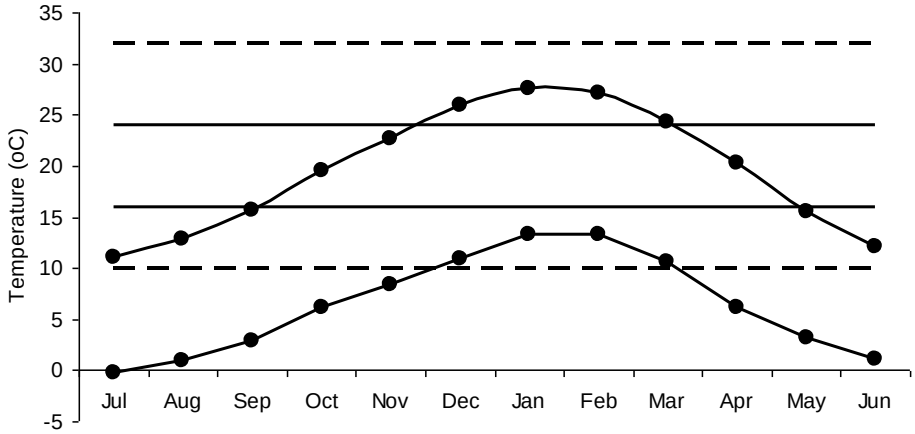
Bathurst

Lat. 33o26' S Long. 149o34' Elev. 713 m

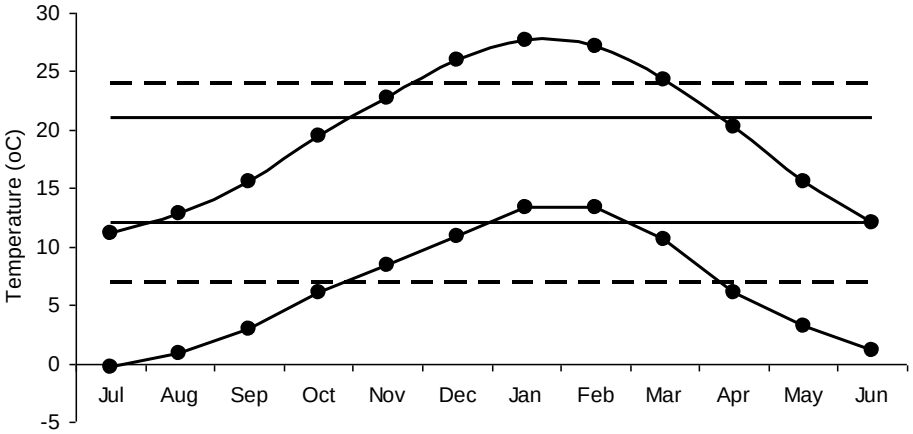
Spinach



European Wild Rocket

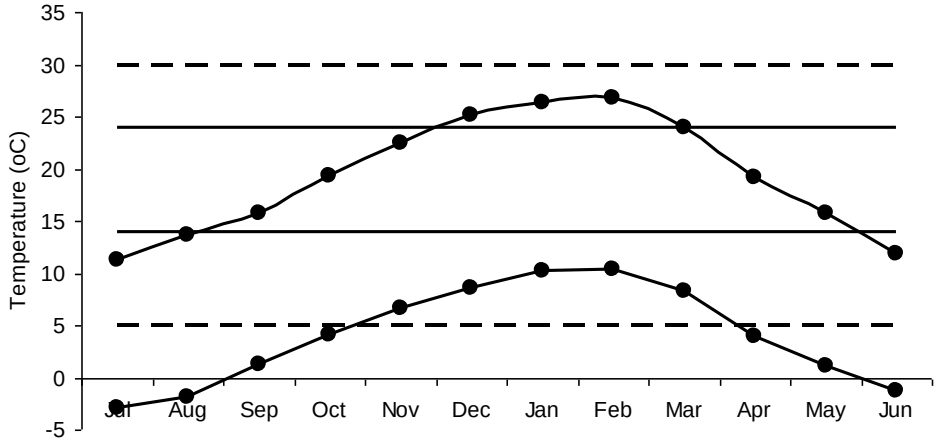


Lettuce

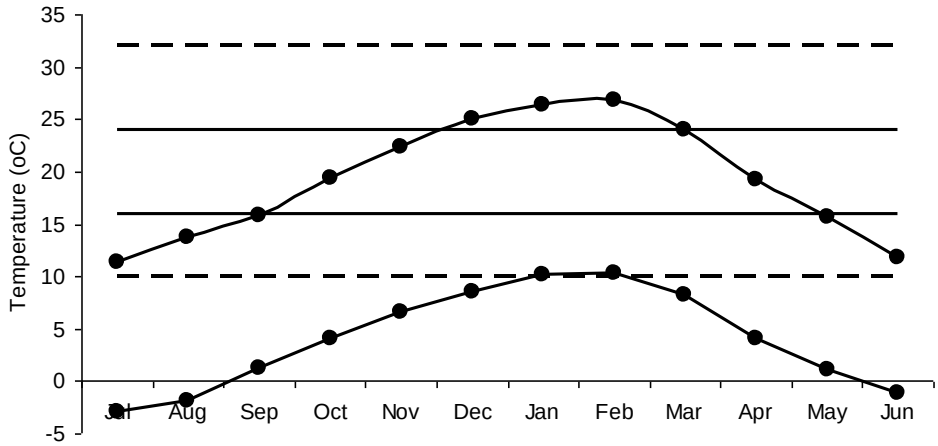


Cooma Lat. 36o14' S Long. 149o7' Elev. 786 m

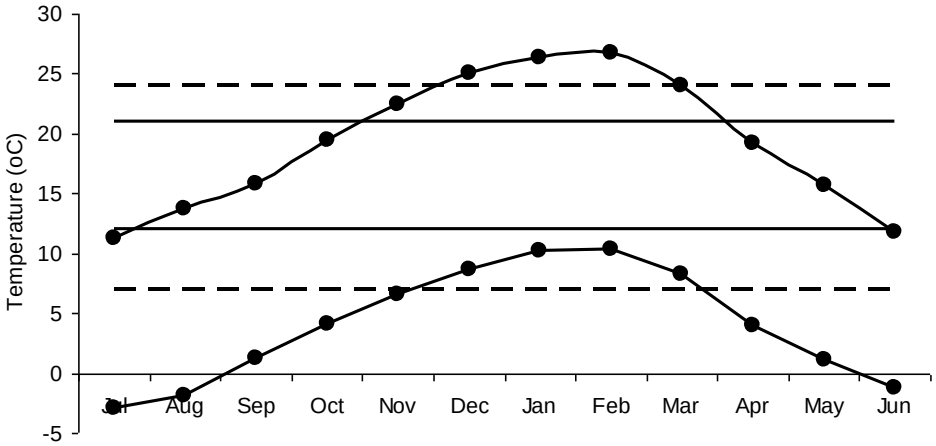
Spinach



European Wild Rocket

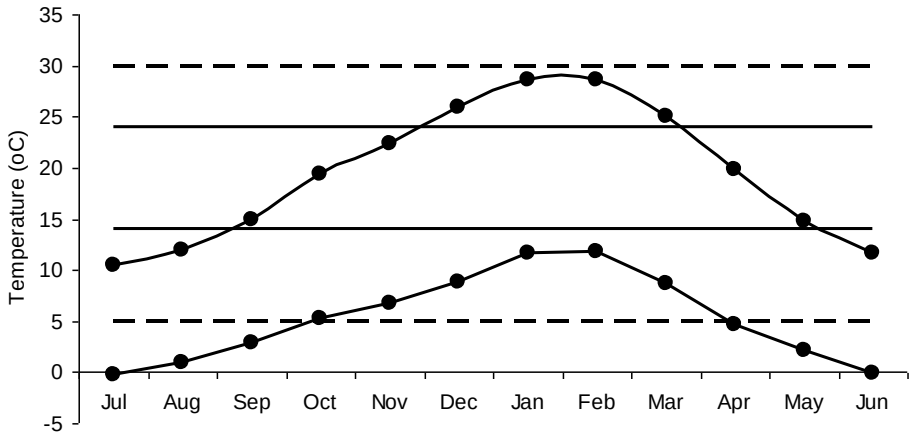


Lettuce

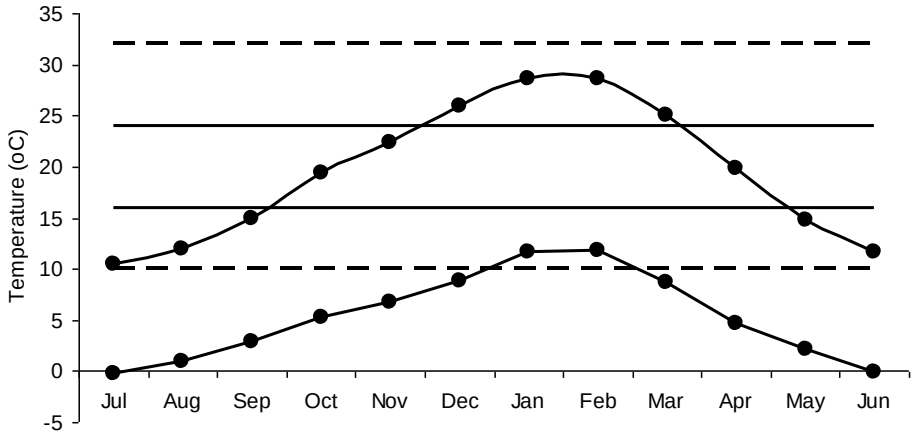


Tumbarumba NSW Lat. 35o47' S Long.148o1' E Elev. 645 m

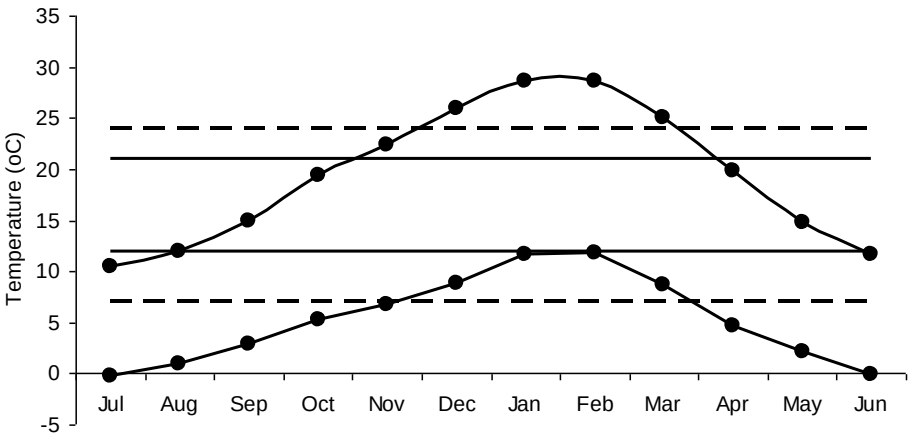
Spinach



European Wild Rocket



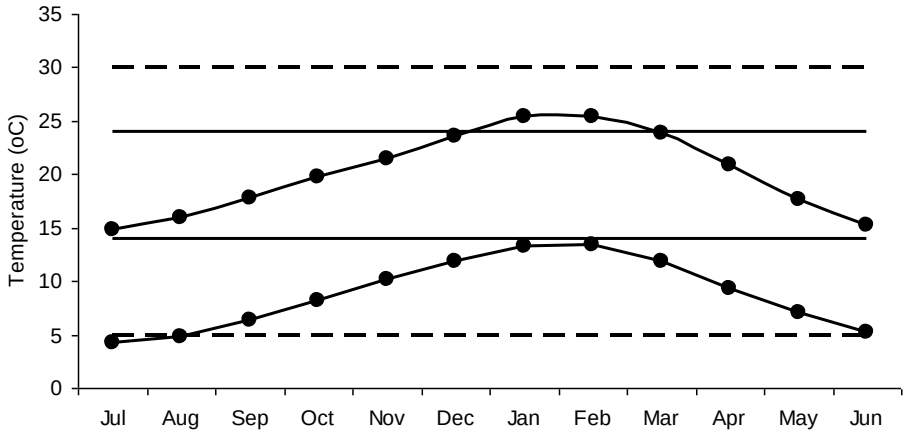
Lettuce



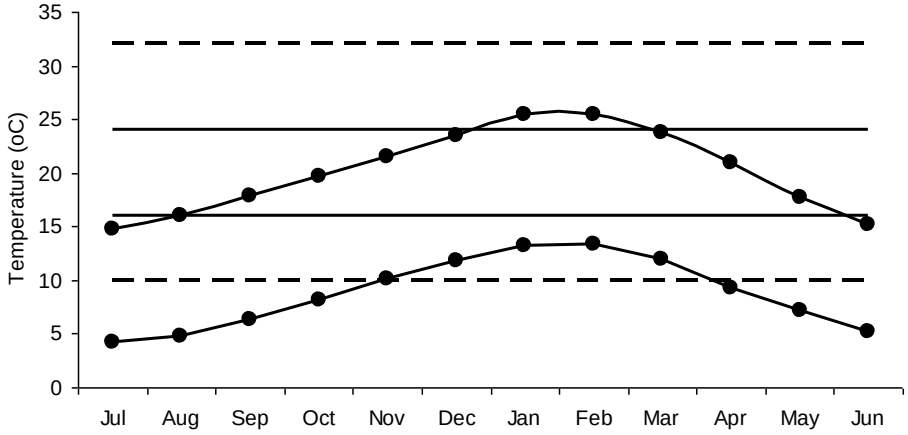
Victoria

Orbost Elevation: 41 m

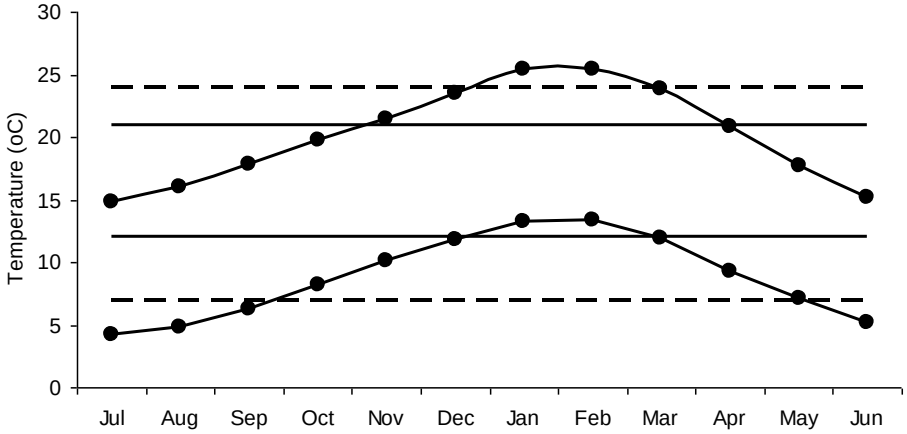
Spinach



European Wild Rocket



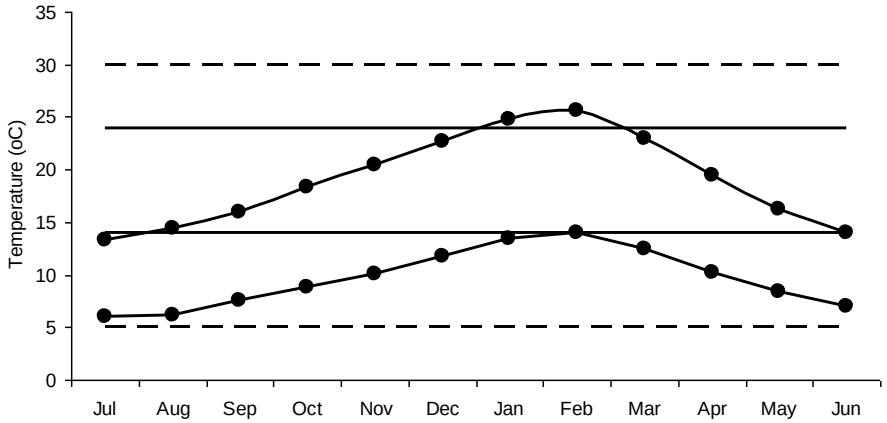
Lettuce



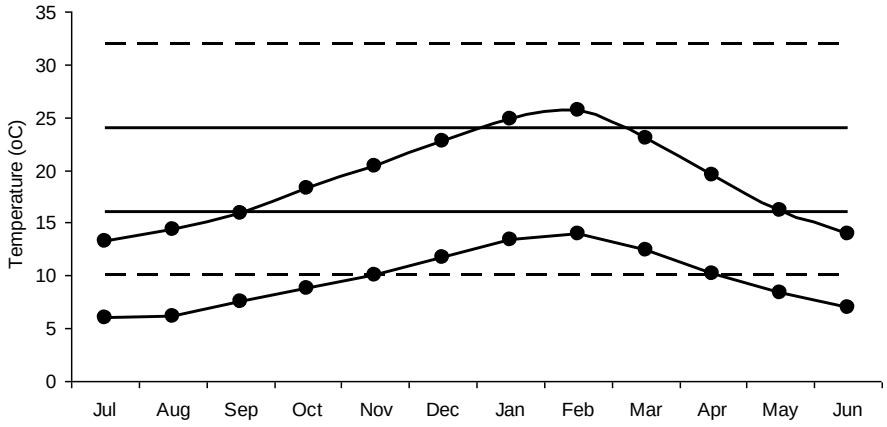
Cranbourne

Latitude:-38.1350 S Longitude: 145.2633 E Elevation: 85.0 m

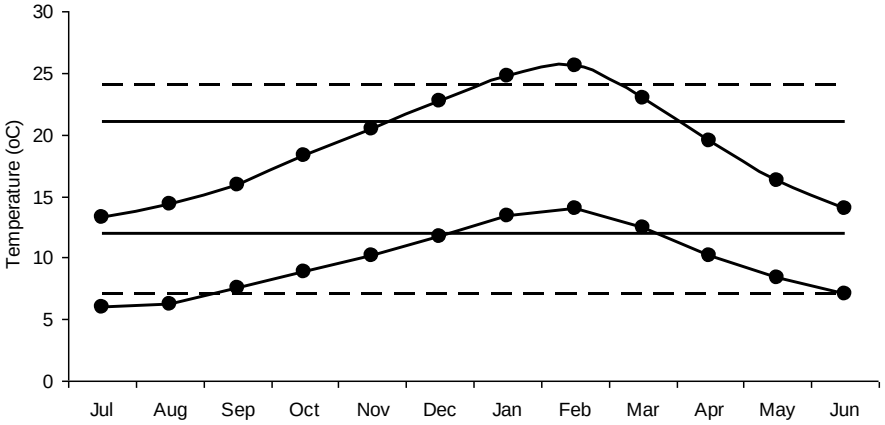
Spinach



European Wild Rocket



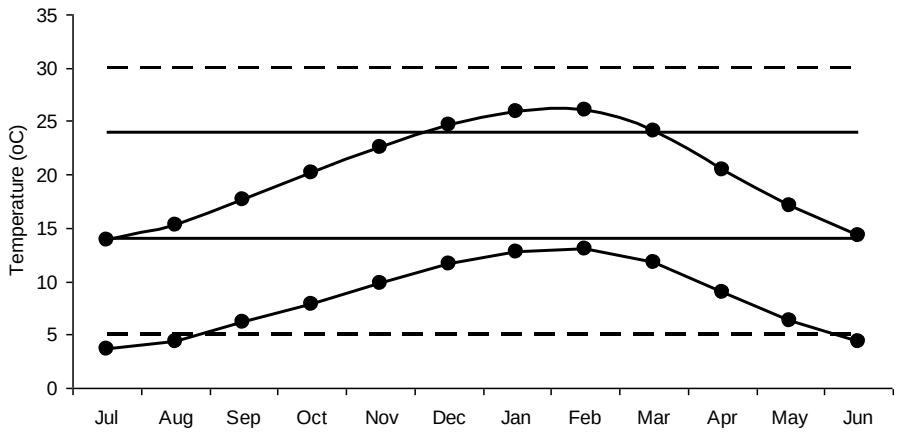
Lettuce



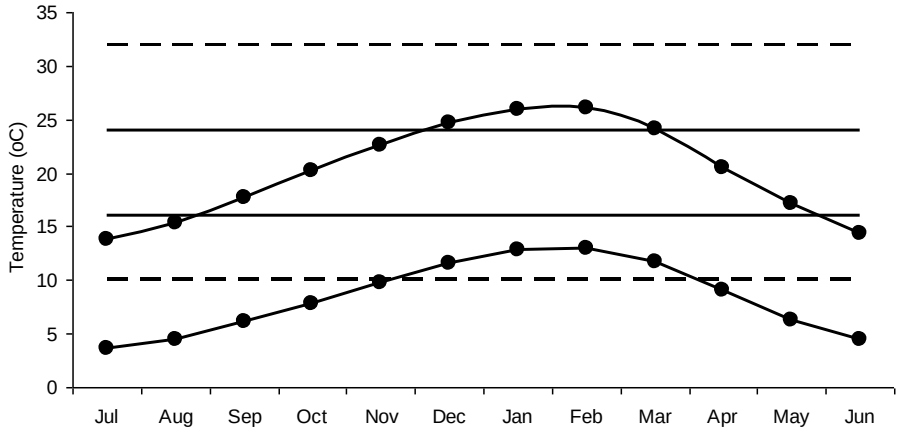
Sale

Latitude:-38.1000 S Longitude: 147.0500 E Elevation: 9.8 m

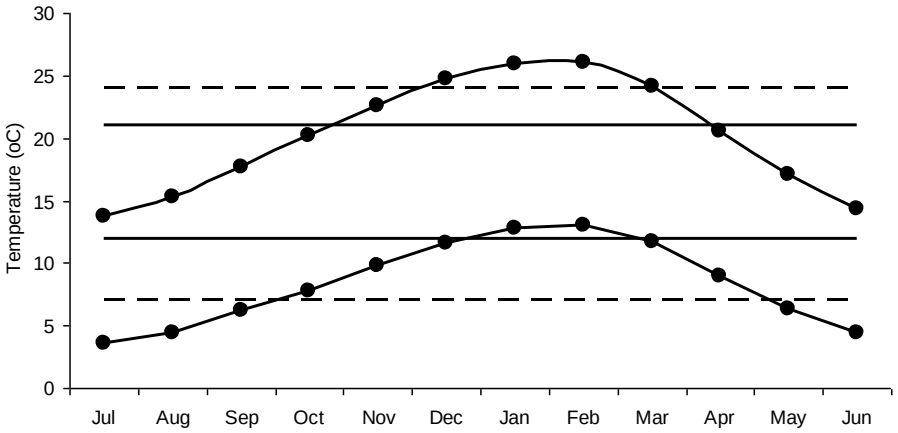
Spinach



European Wild Rocket



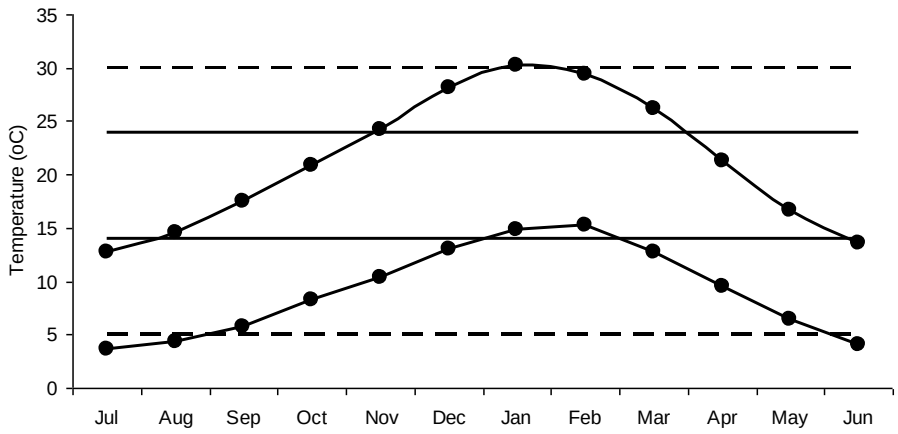
Lettuce



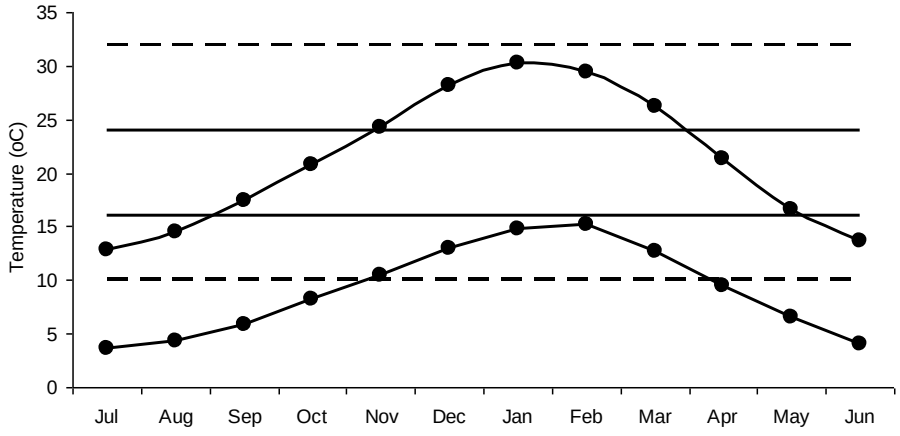
Rochester

Latitude:-36.3628 S Longitude: 144.7094 E Elevation: 105.0 m

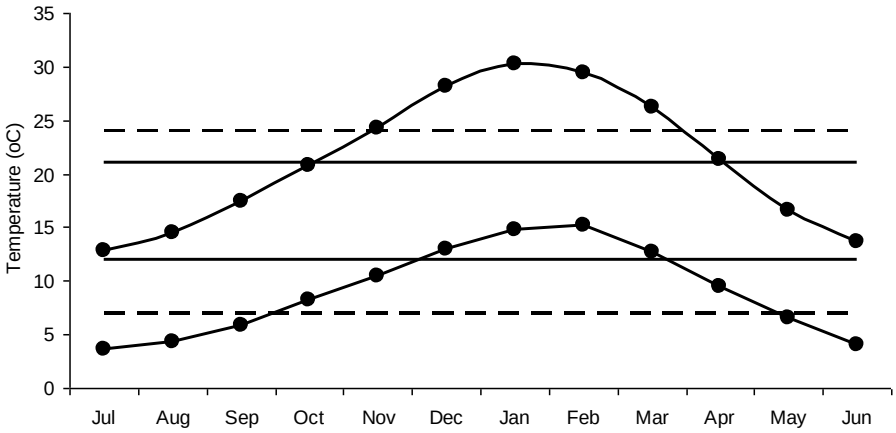
Spinach



European Wild Rocket



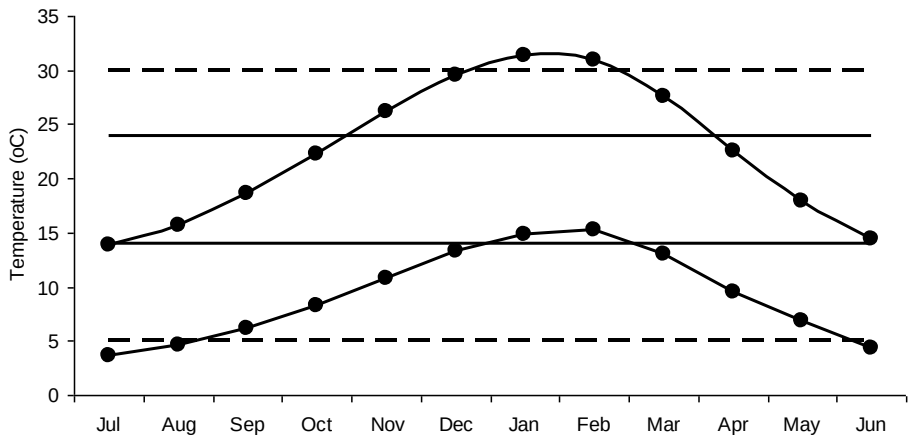
Lettuce



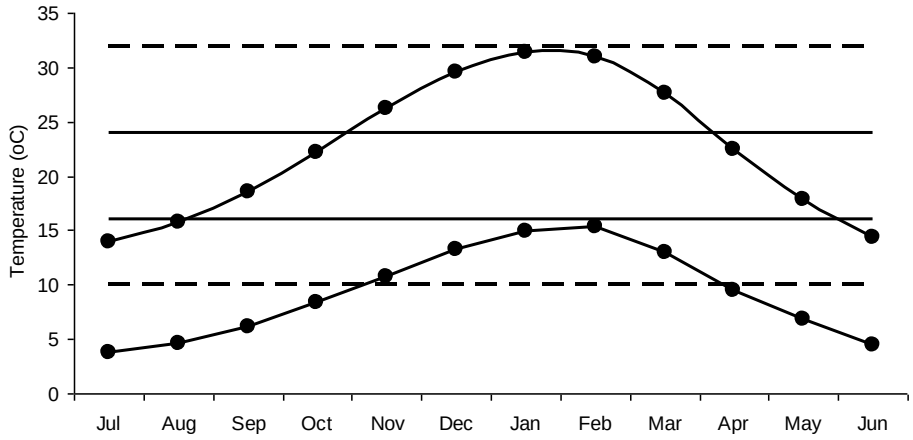
Boort

Latitude:-36.1175 S Longitude: 143.7214 E Elevation: 90.0 m

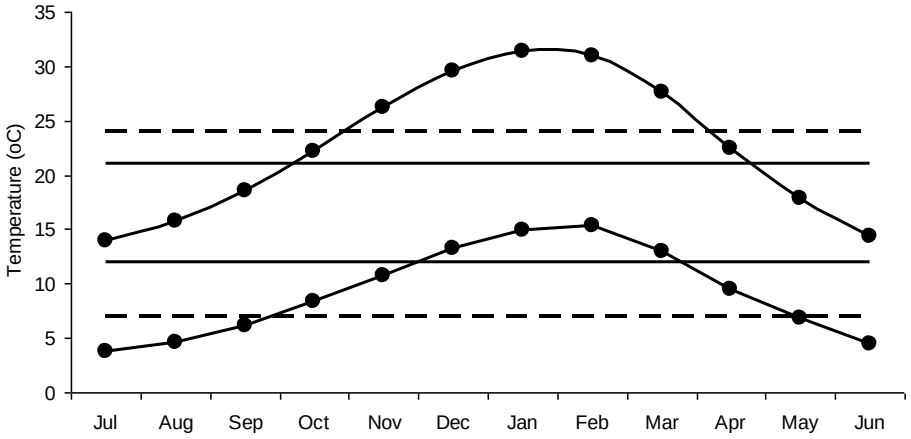
Spinach



European Wild Rocket



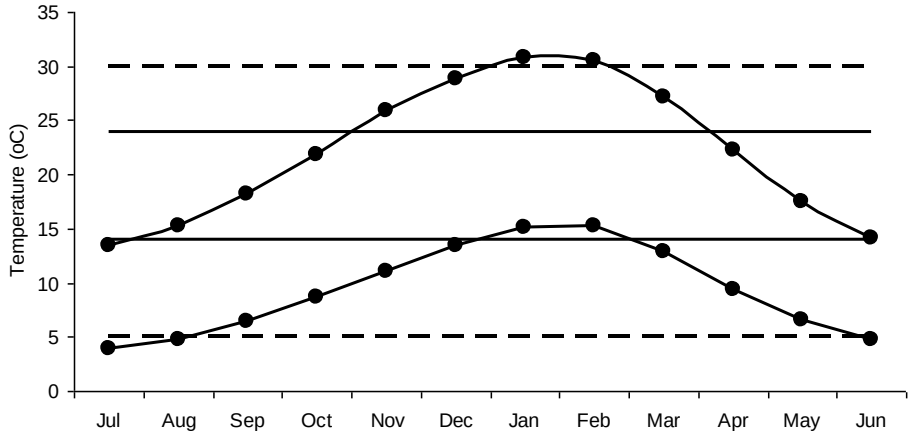
Lettuce



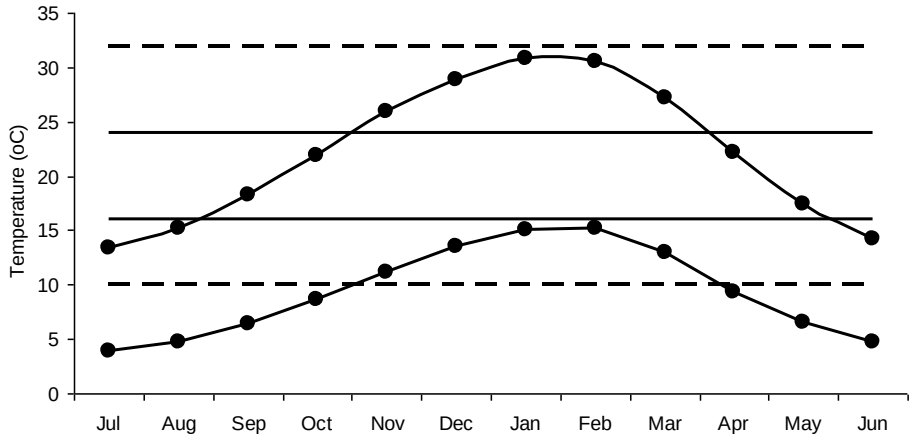
Echuca

Latitude:-36.1661 S Longitude: 144.7631 E Elevation: 96.0 m

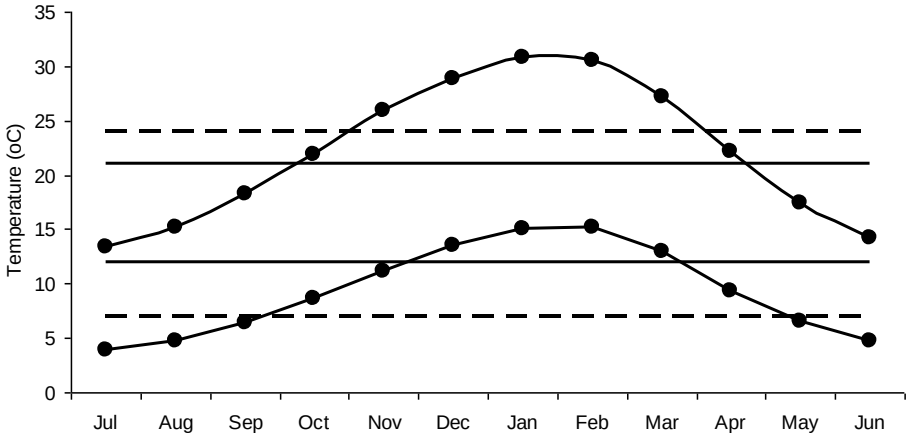
Spinach



European Wild Rocket



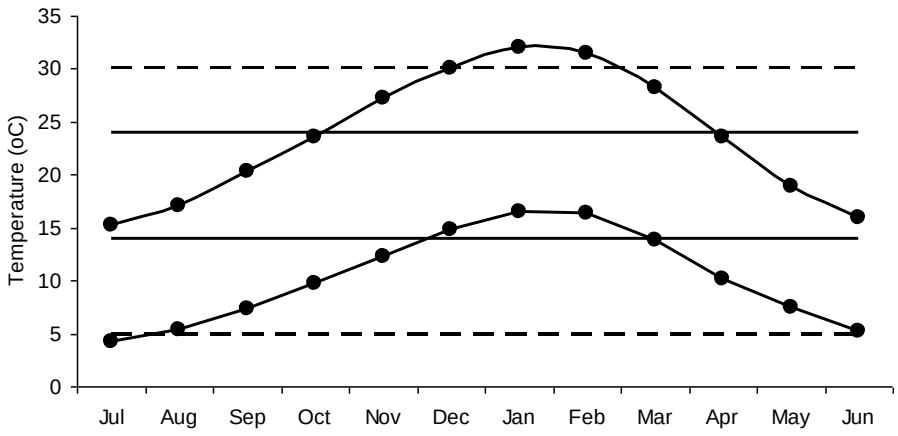
Lettuce



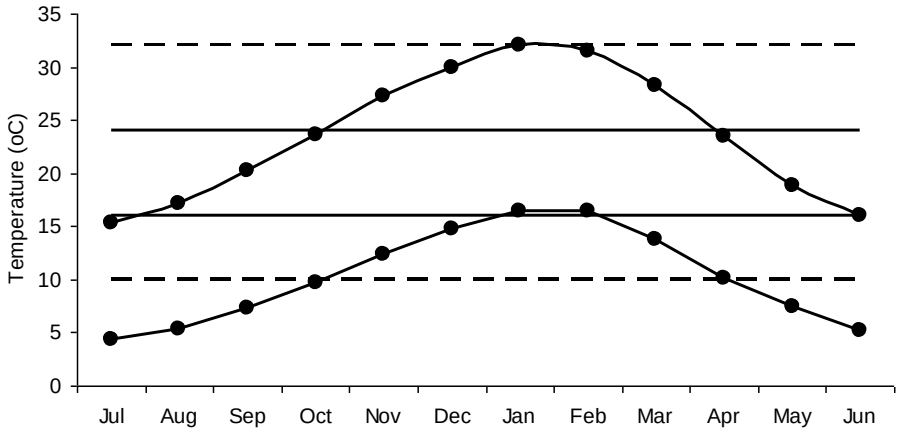
Mildura

Latitude:-34.2306 S Longitude: 142.0839 E Elevation: 50.0 m

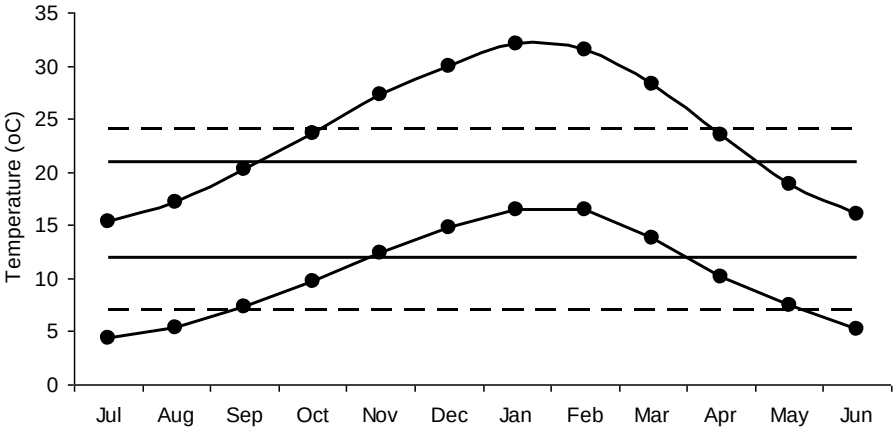
Spinach



European Wild Rocket



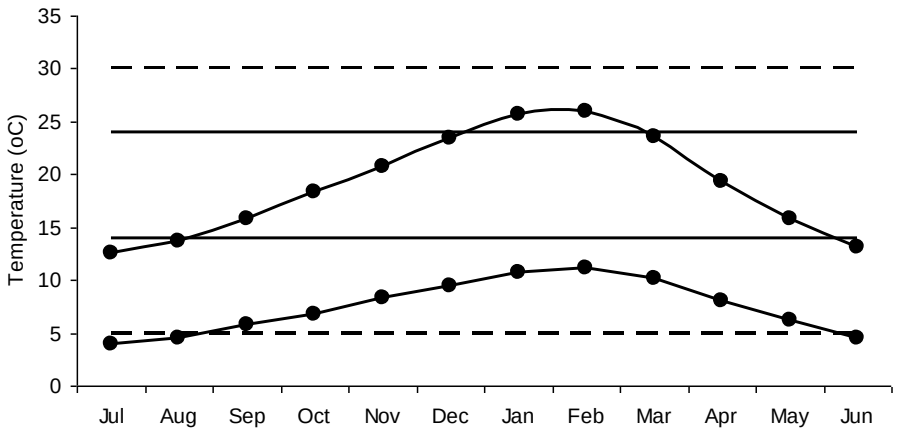
Lettuce



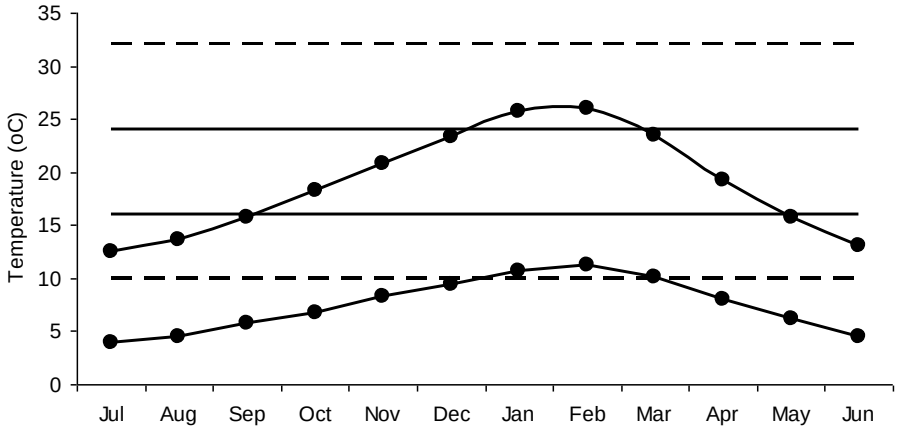
Colac

Latitude:-38.3425 S Longitude: 143.5850 E Elevation: 134.0 m

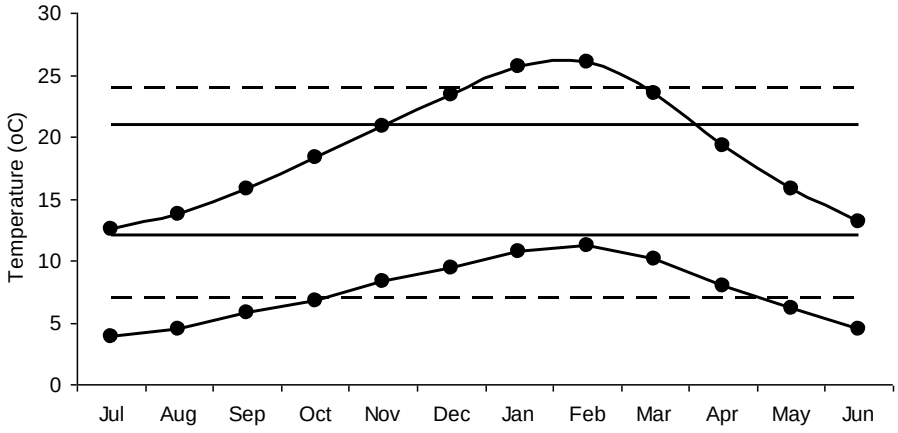
Spinach



European Wild Rocket

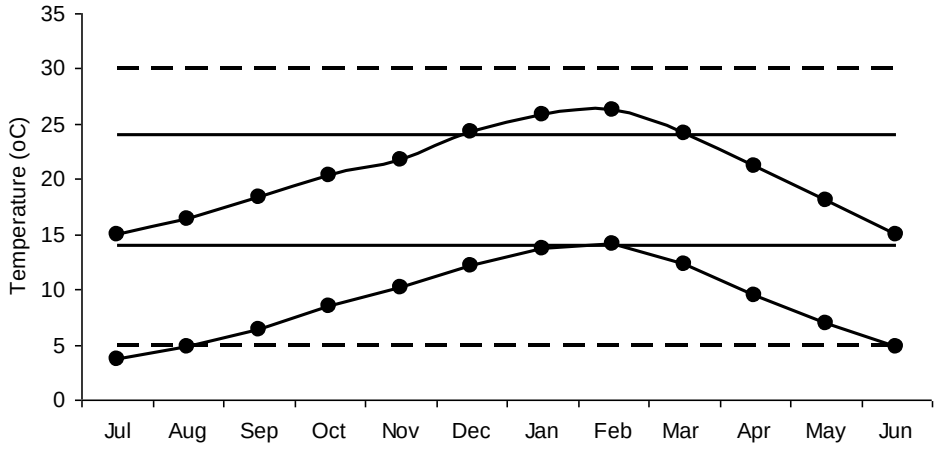


Lettuce

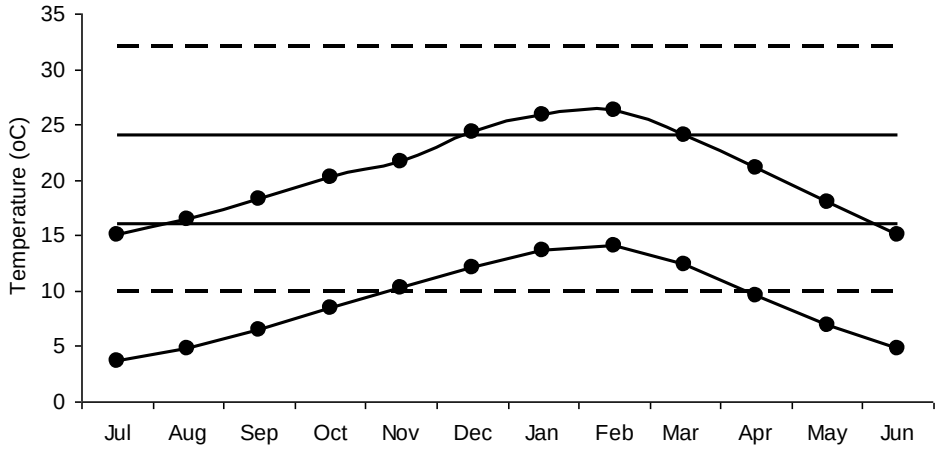


Bairnsdale

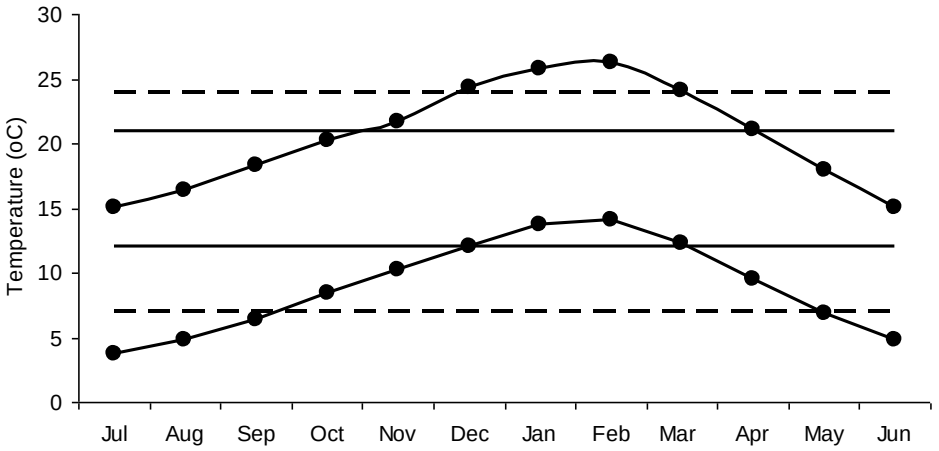
Spinach



European Wild Rocket



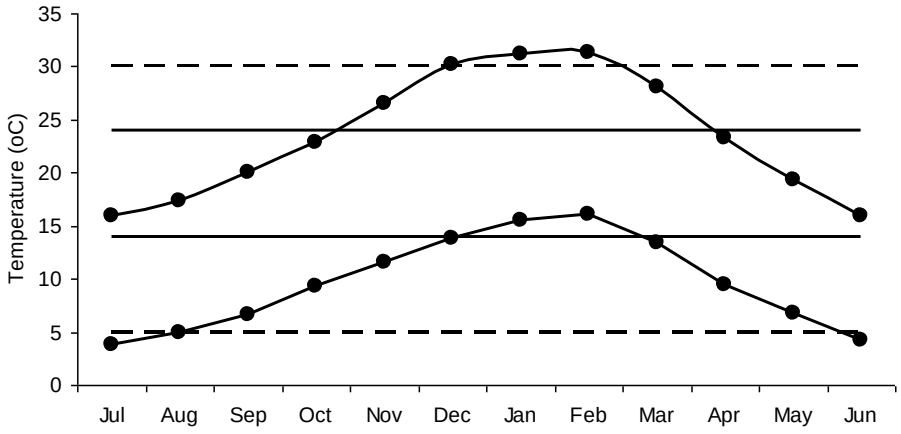
Lettuce



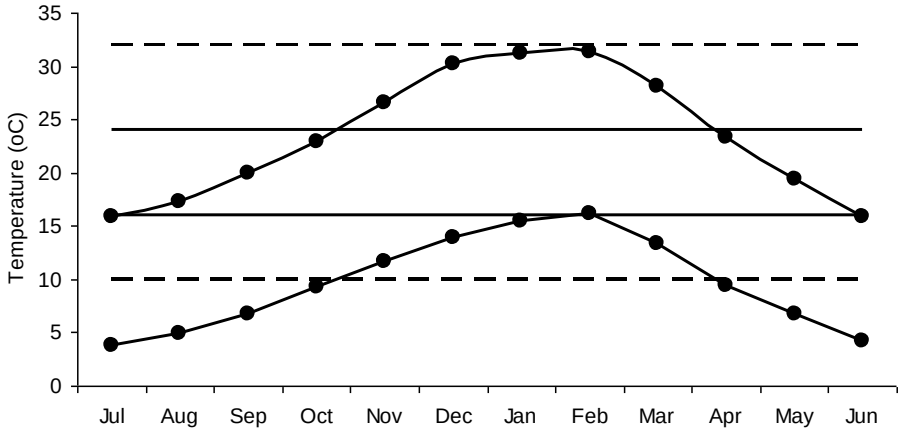
Robinvale (Wemen)

Lat. 34o36' S Long.142o47' E Elev. 49m

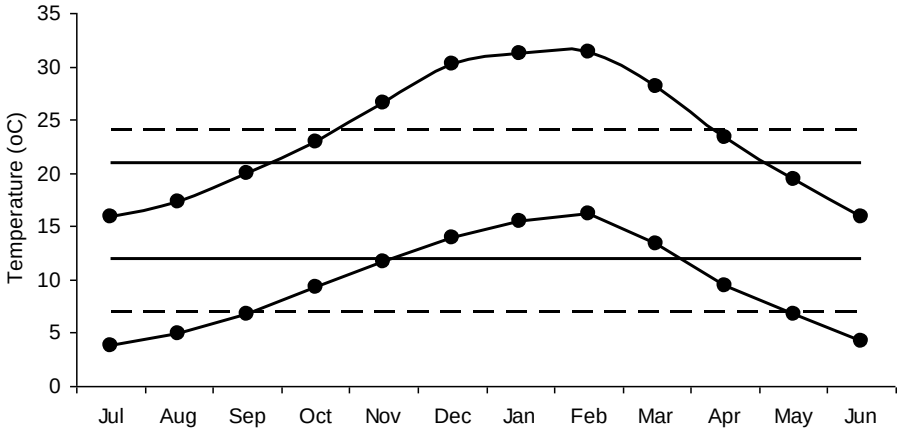
Spinach



European Wild Rocket



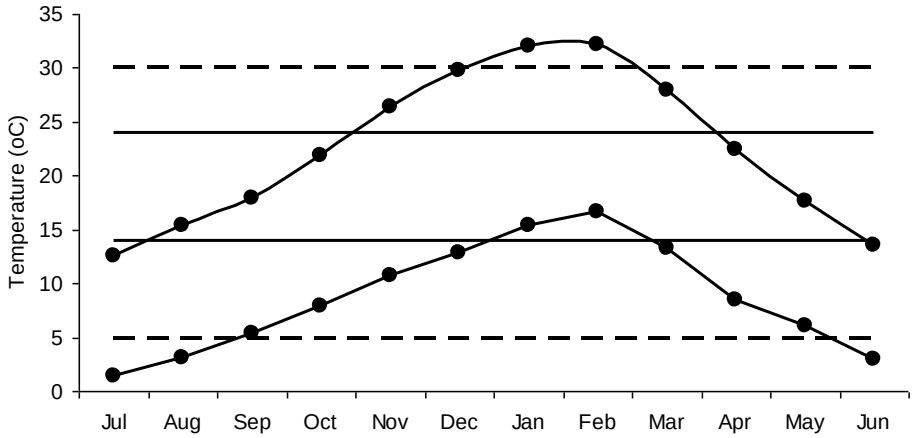
Lettuce



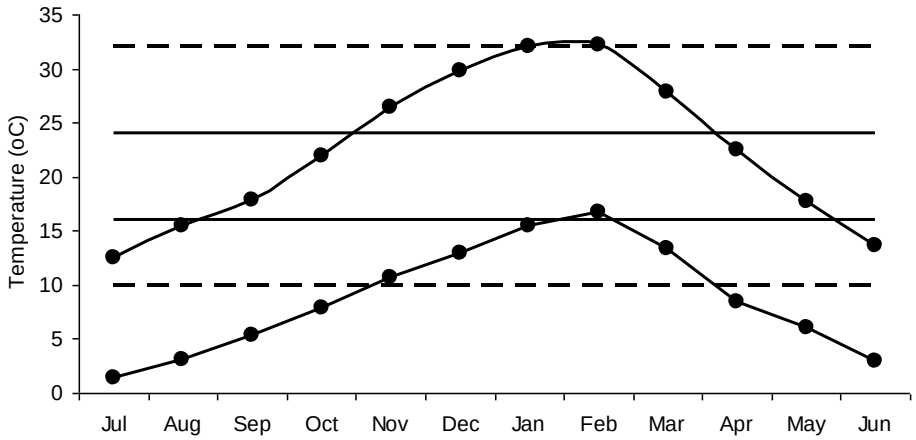
Gundagai

Lat. 35o 5' S Long.148o 6' E Elev. 232 m

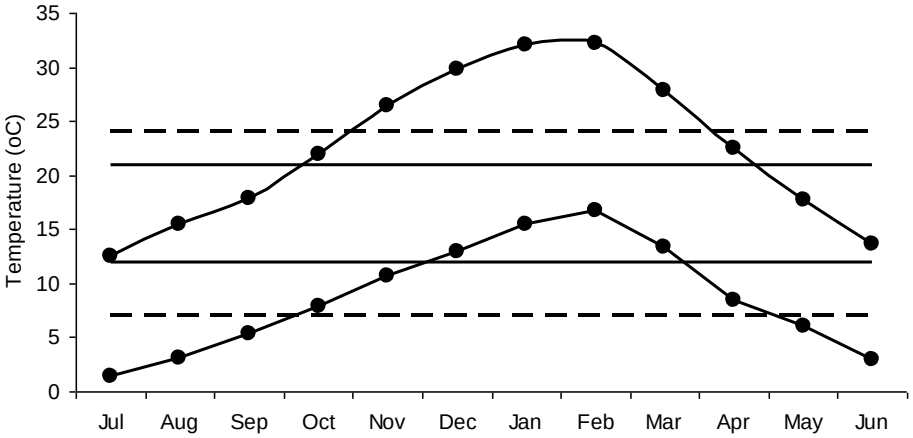
Spinach



European Wild Rocket



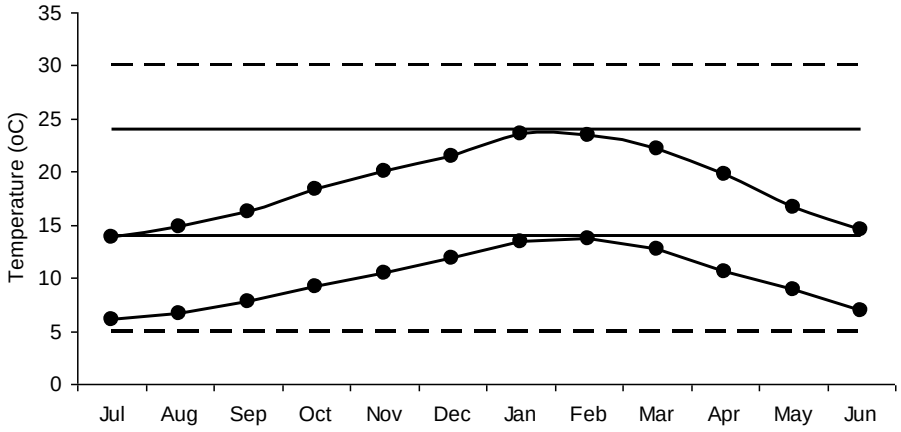
Lettuce



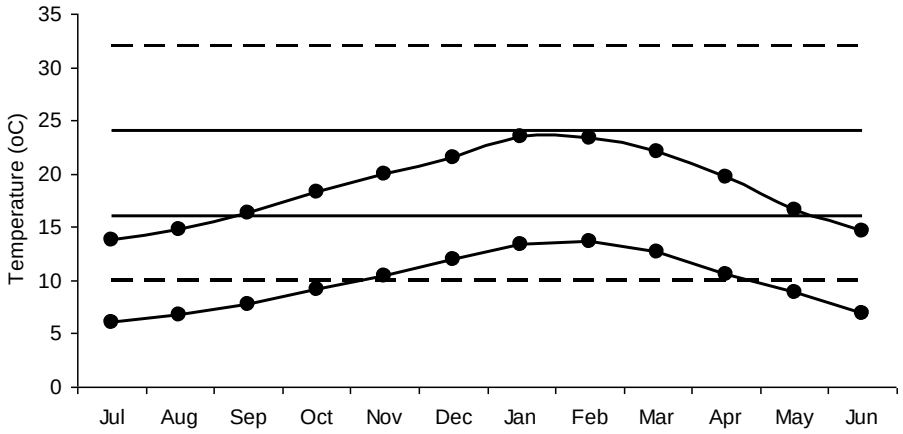
Warrnambool

Lat. 38o 24' S Long. 142o 29' Elev. 21.0 m

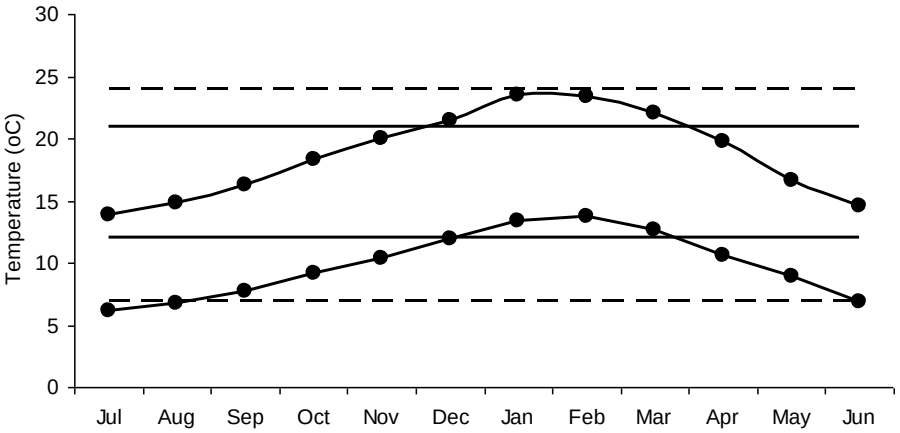
Spinach



European Wild Rocket



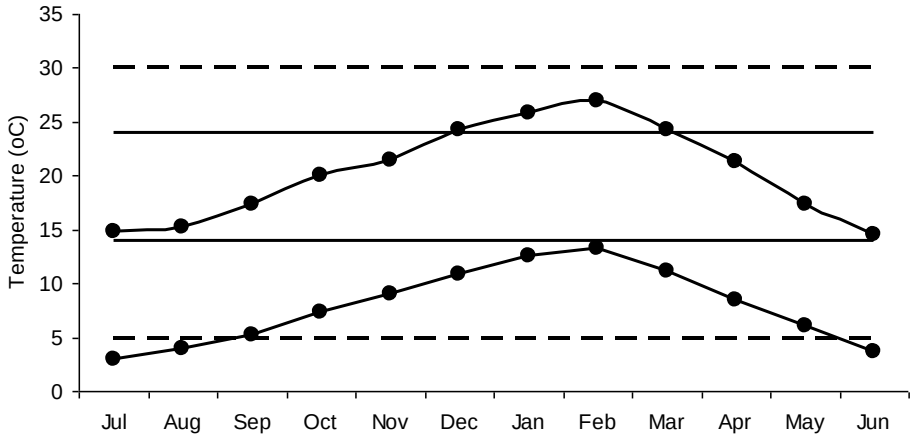
Lettuce



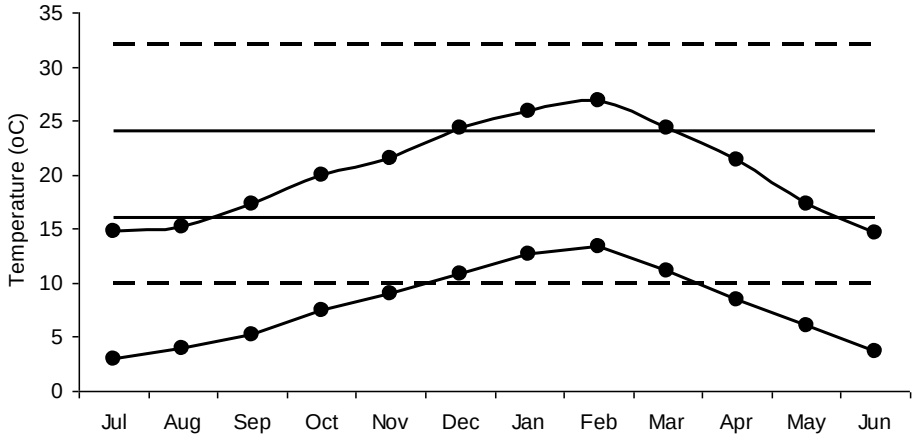
Maffra

Lat. 37o58' S Long.146o56' E Elev. 27m

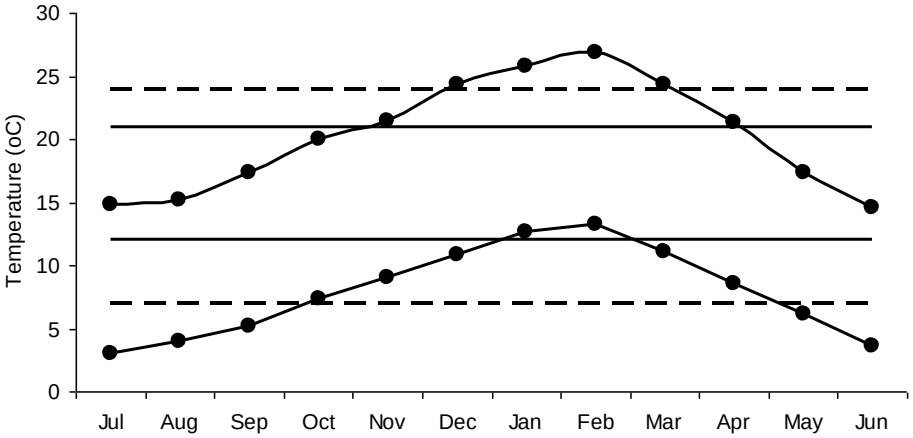
Spinach



European Wild Rocket



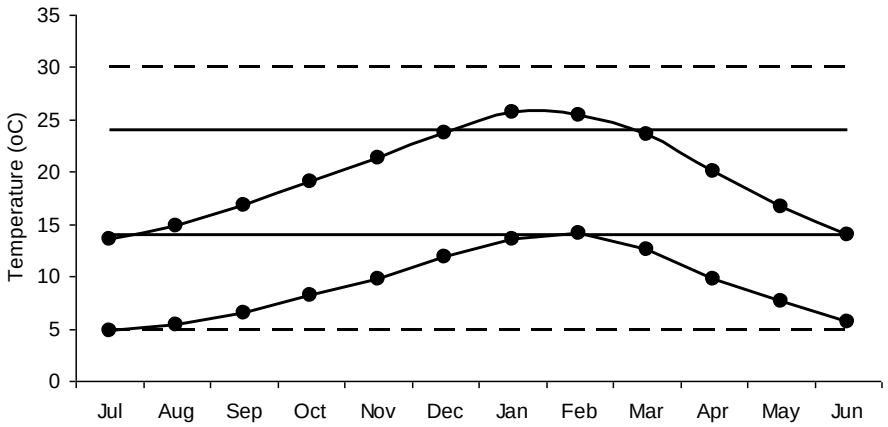
Lettuce



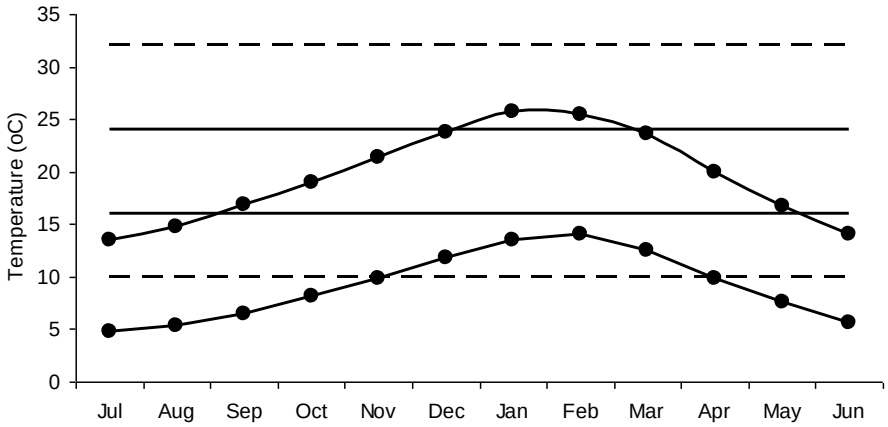
Werribee (Laverton)

Lat. 37o 52' S Long.144o 45' E Elev. 16 m

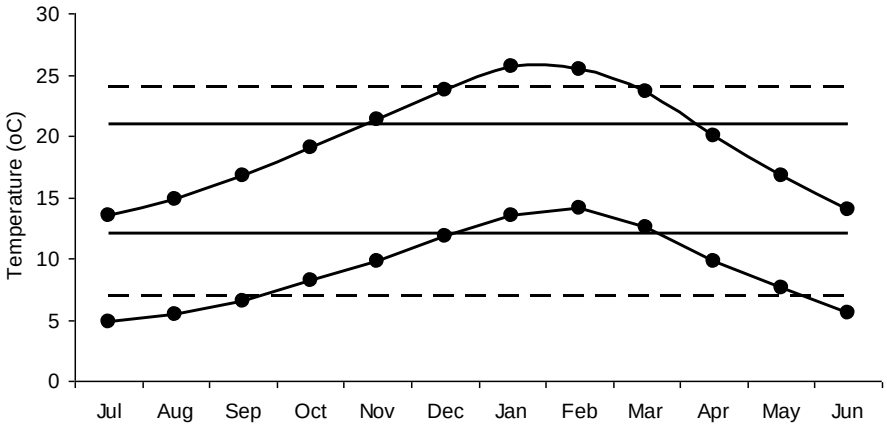
Spinach



European Wild Rocket



Lettuce

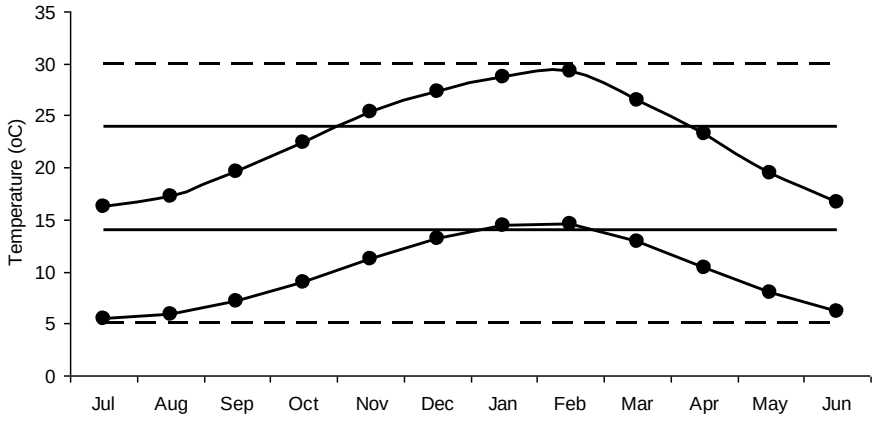


South Australia

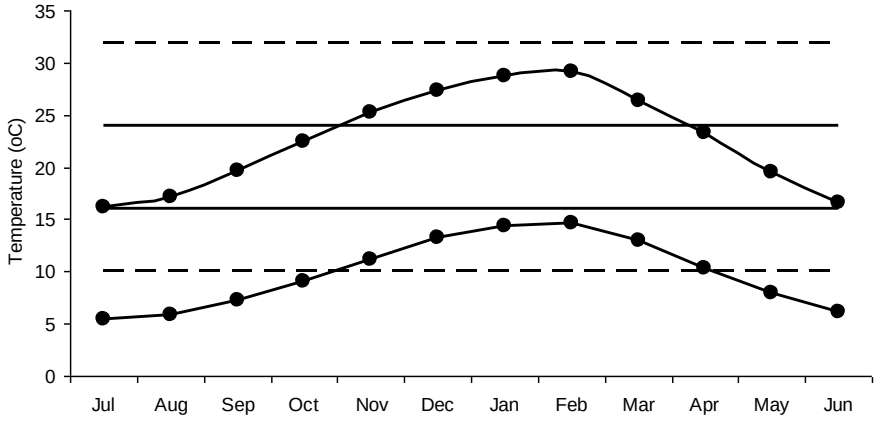
Murray Bridge, SA

Latitude:-35.1234 S Longitude: 139.2592 E Elevation: 33.0 m

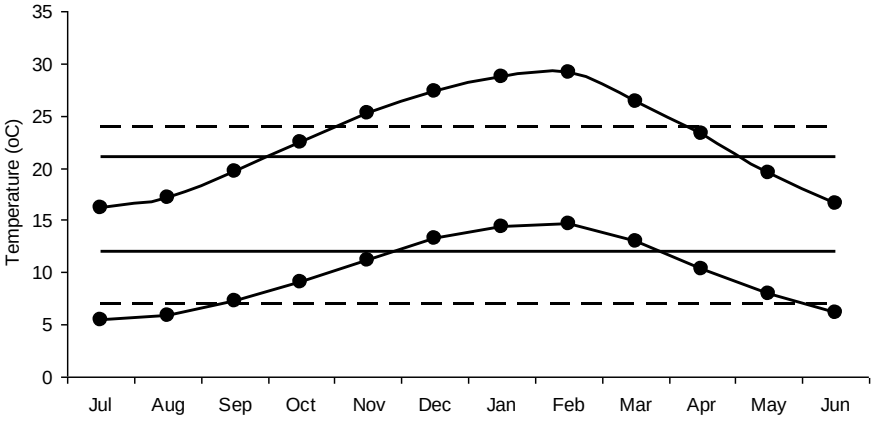
Spinach



European Wild Rocket



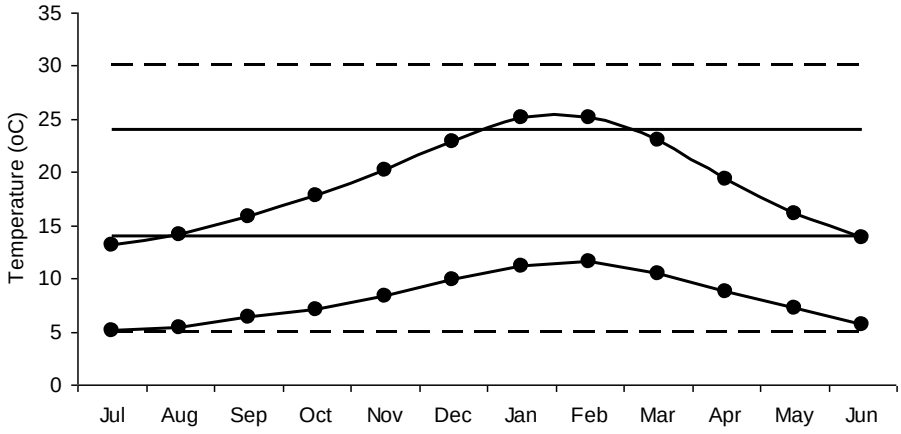
Lettuce



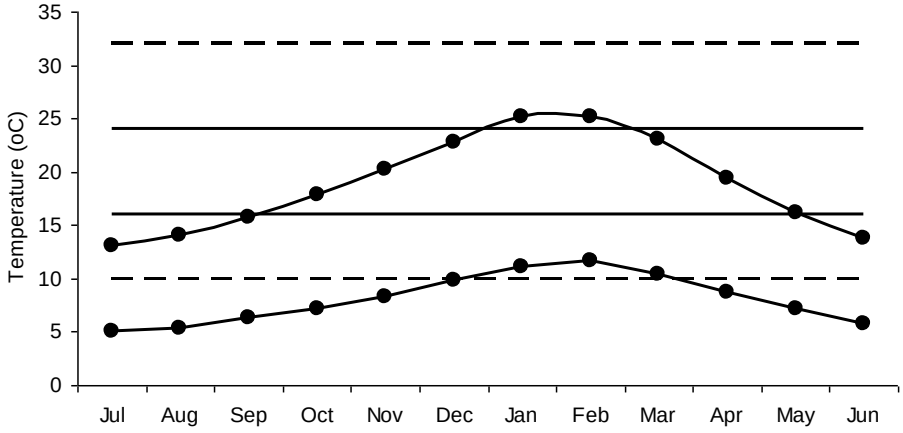
Mt Gambier

Elevation: 63 m

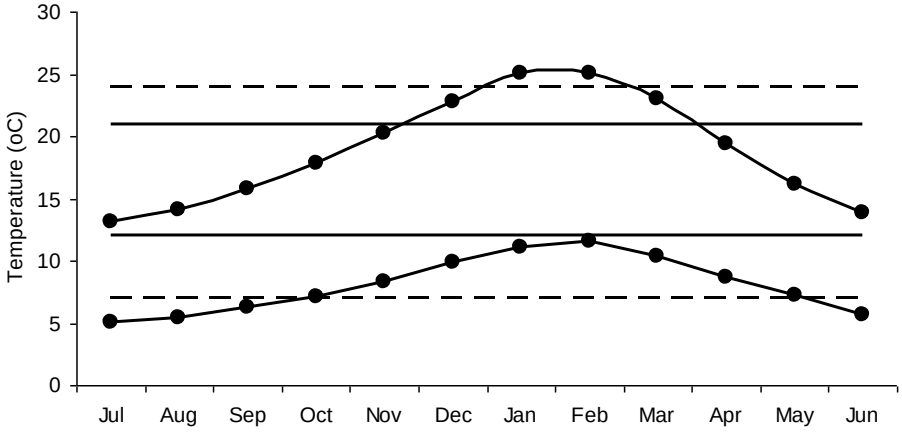
Spinach



European Wild Rocket



Lettuce

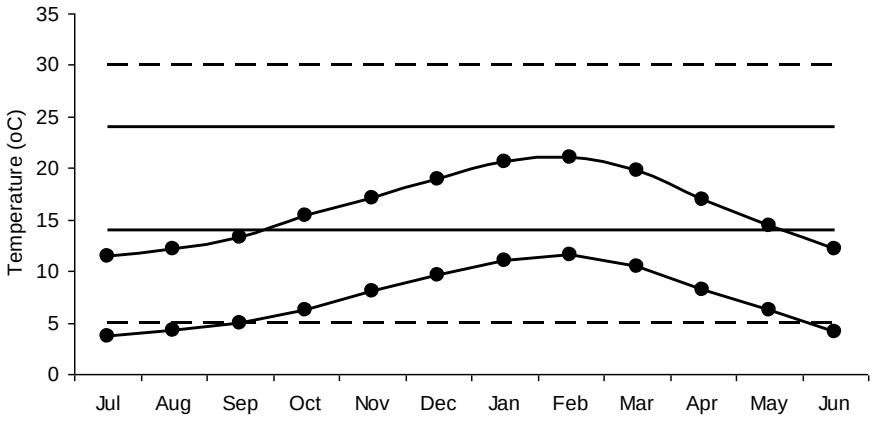


Tasmania

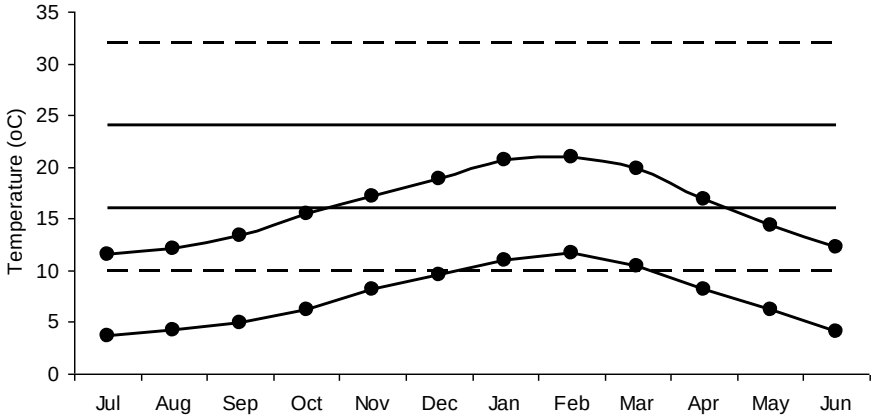
Forth

Elevation: 120 m

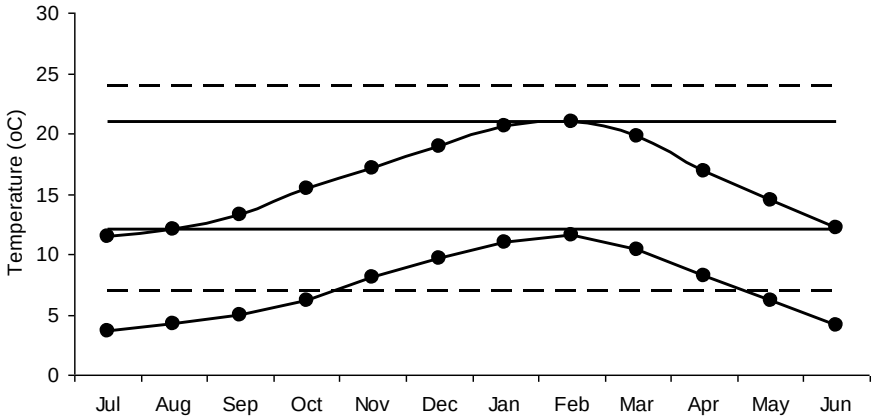
Spinach



European Wild Rocket



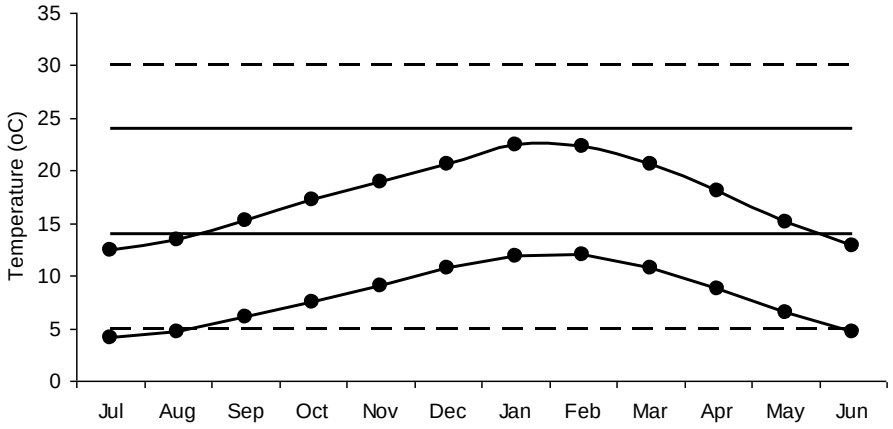
Lettuce



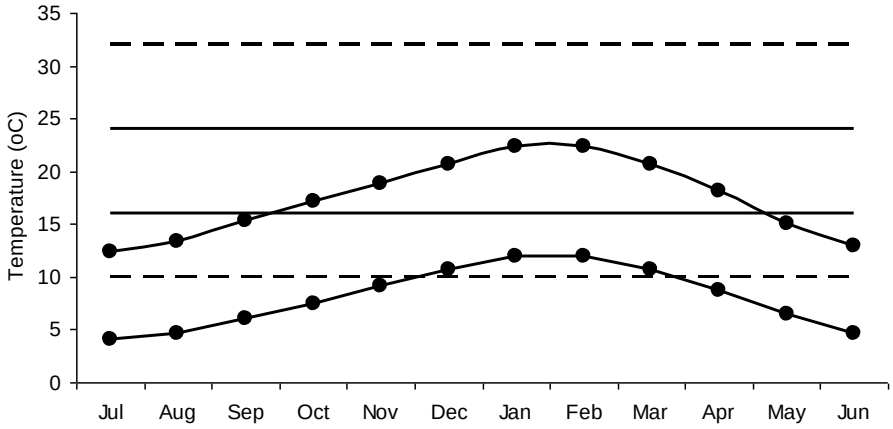
Hobart

Elevation: 4 m

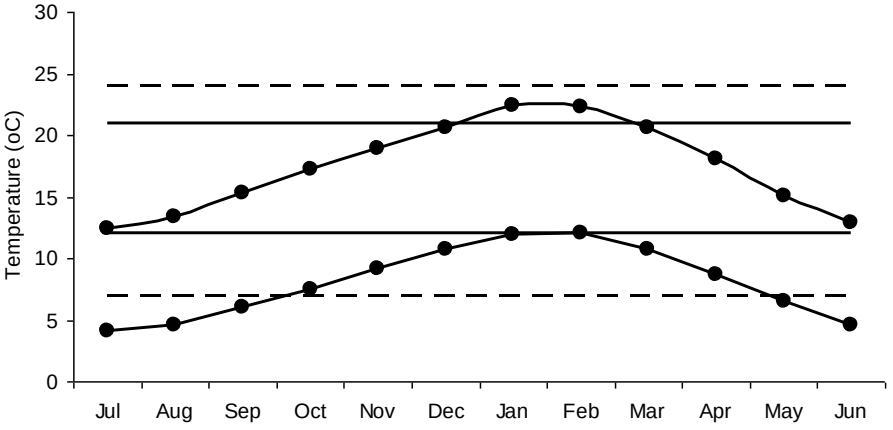
Spinach



European Wild Rocket



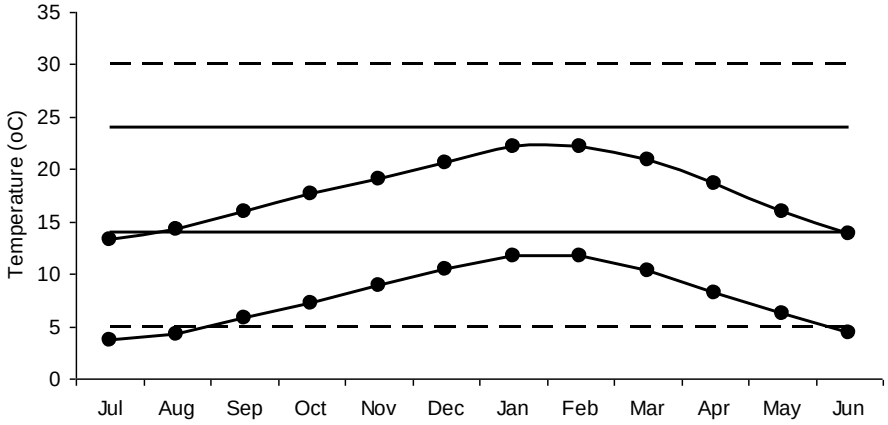
Lettuce



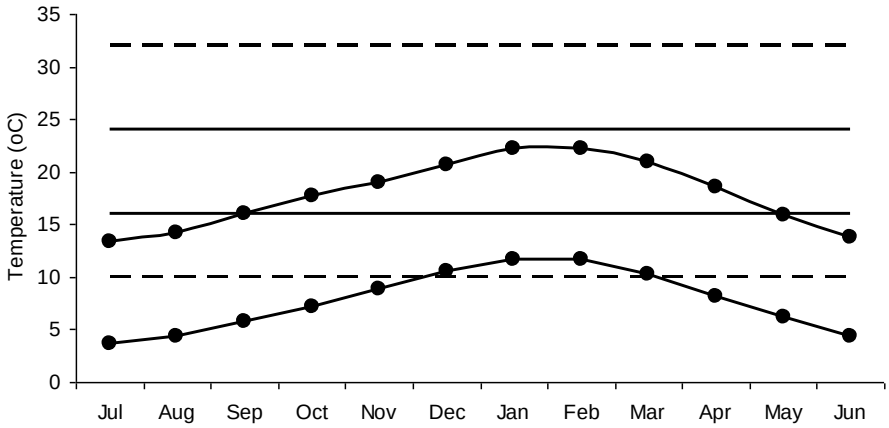
Swansea (Tas)

Elevation: 11 m

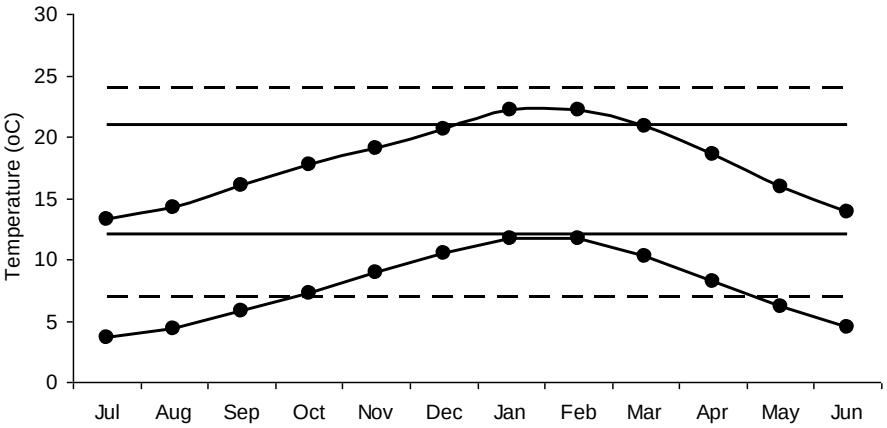
Spinach



European Wild Rocket



Lettuce

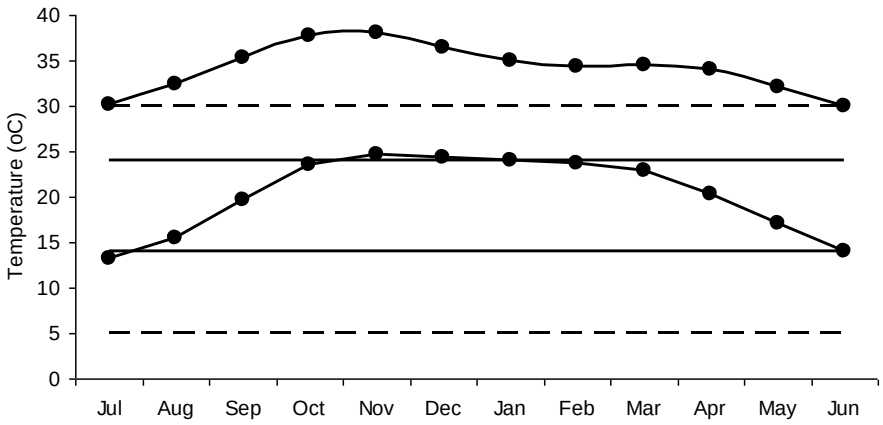


Northern Territory

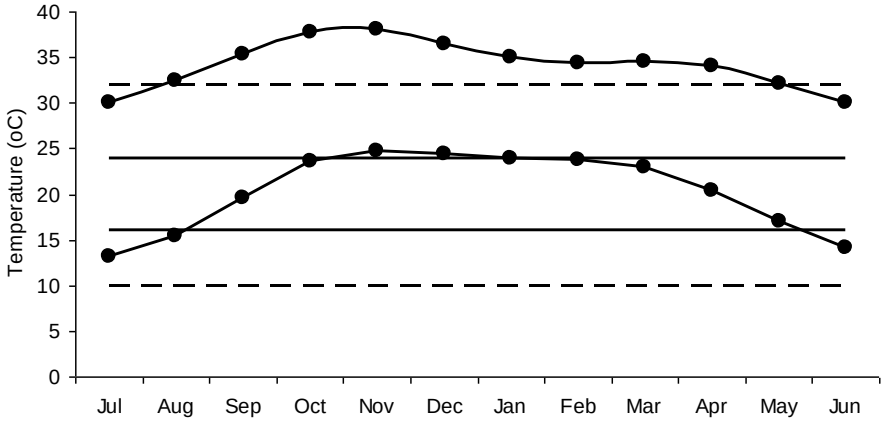
Katherine

Latitude:-14.4589 S Longitude: 132.2572 E Elevation: 103.0 m

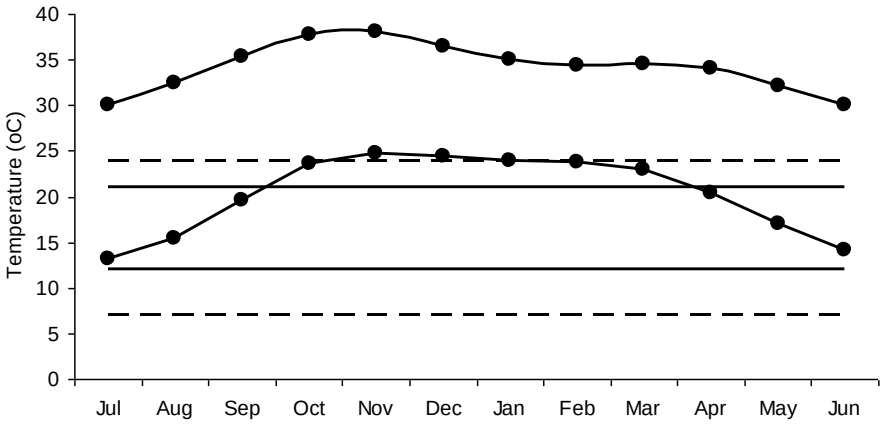
Spinach



European Wild Rocket



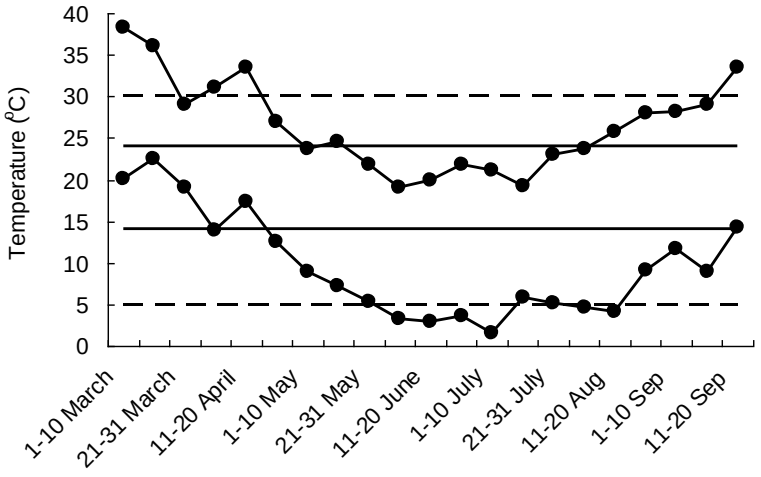
Lettuce



Ti Tree (from Territory Grapes)

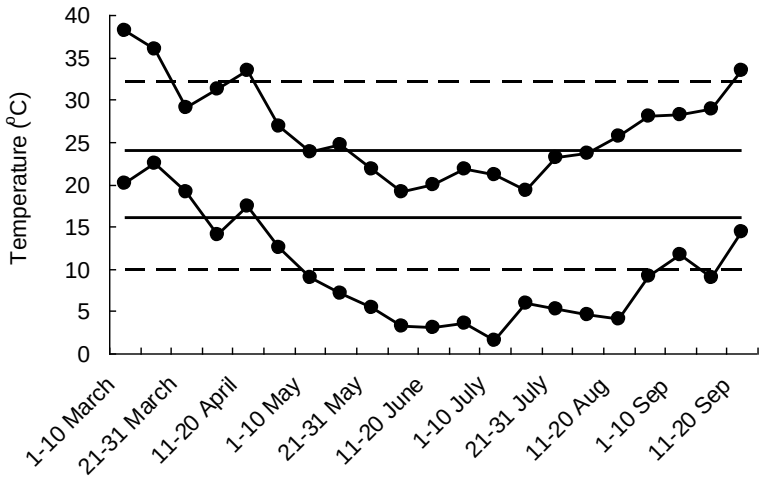
Spinach

Ti Tree (NT) 10 day averages March-September 2006



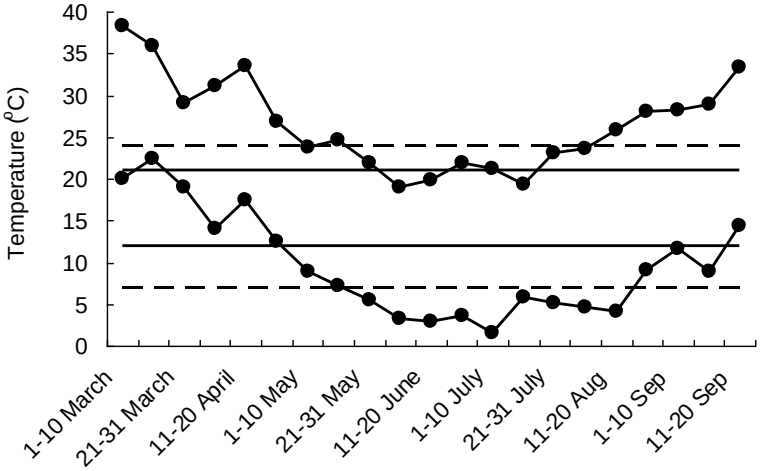
European Wild Rocket

Ti Tree (NT) 10 day averages March-September 2006



Lettuce

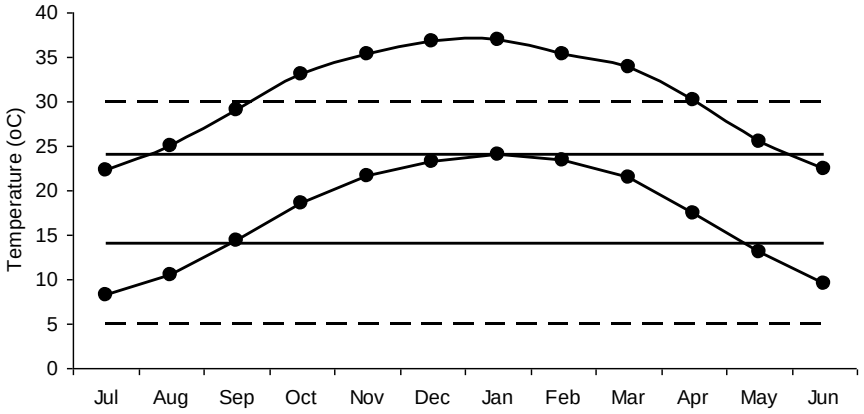
Ti Tree (NT) 10 day averages March-September 2006



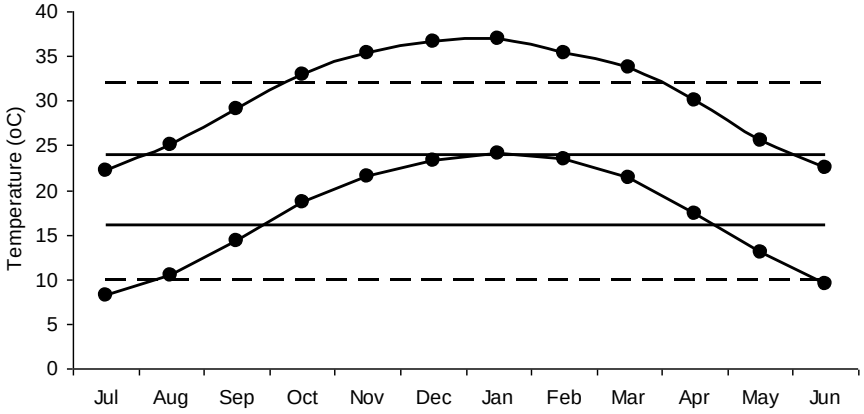
Ti Tree (Barrow Creek)

Latitude:-21.5318 S Longitude: 133.8902 E Elevation: 510.5 m

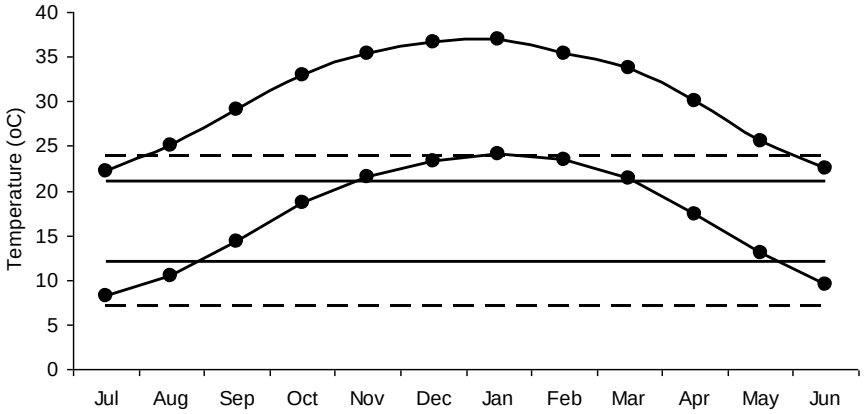
Spinach



European Wild Rocket



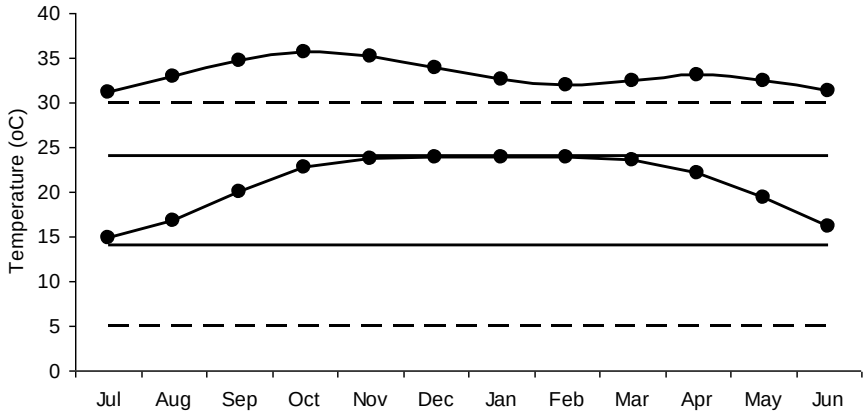
Lettuce



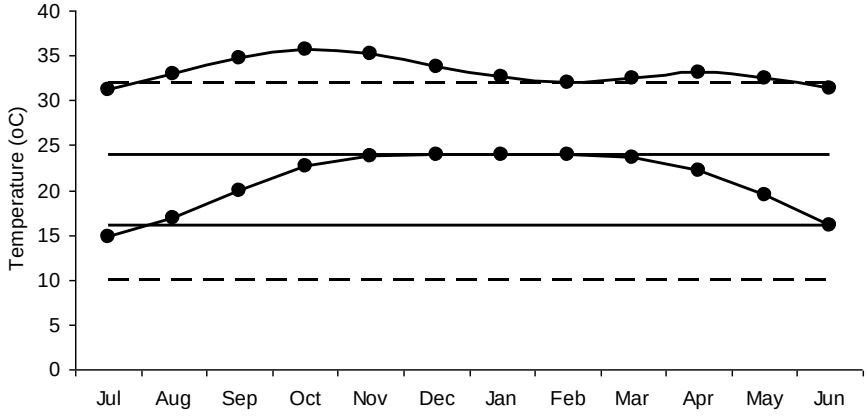
Middle Point (Humpty Doo)

Elevation: 10 m

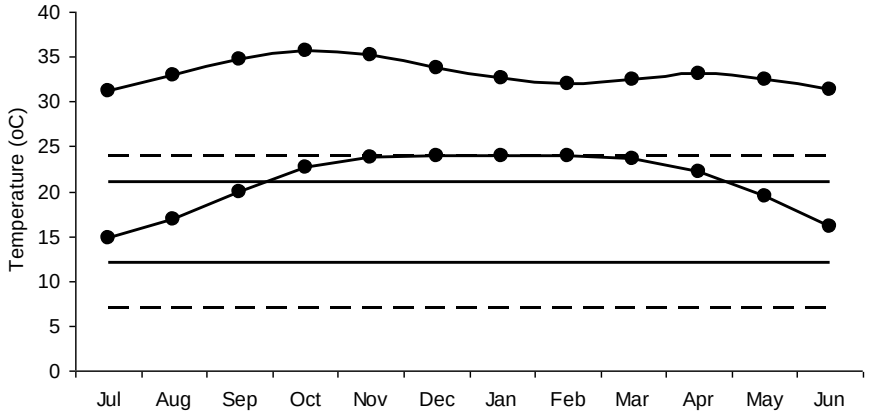
Spinach



European Wild Rocket



Lettuce

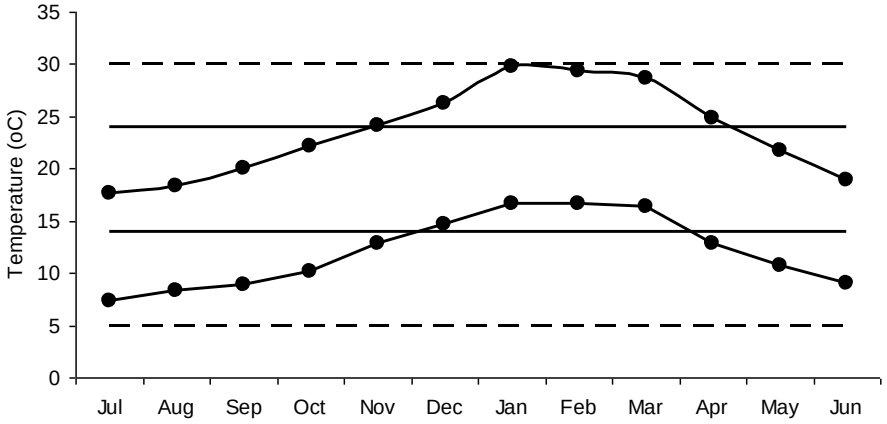


Western Australia

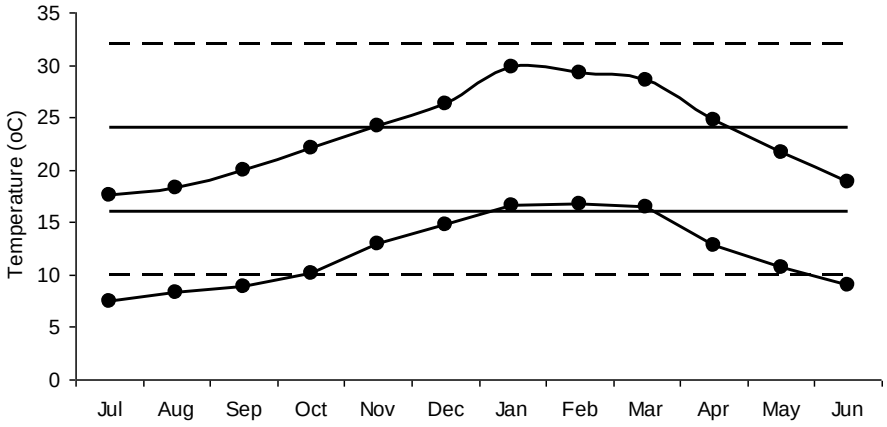
Wanneroo

Lat.31o 47' S Long.115o 46' E Alt. 17m

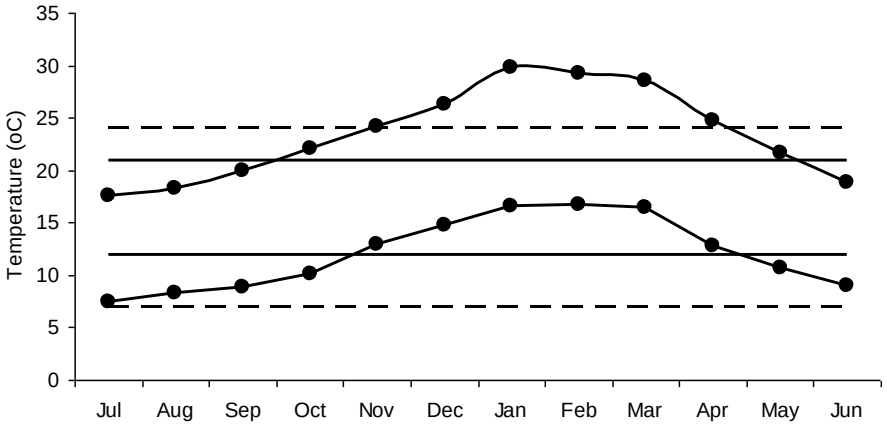
Spinach



European Wild Rocket



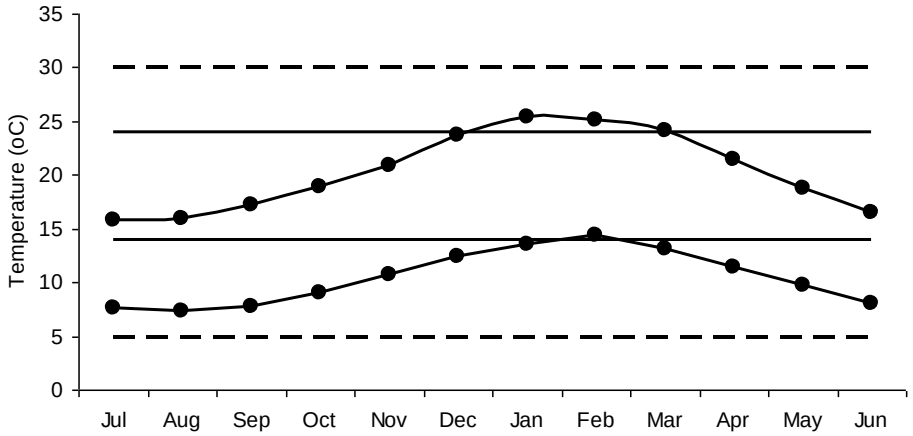
Lettuce



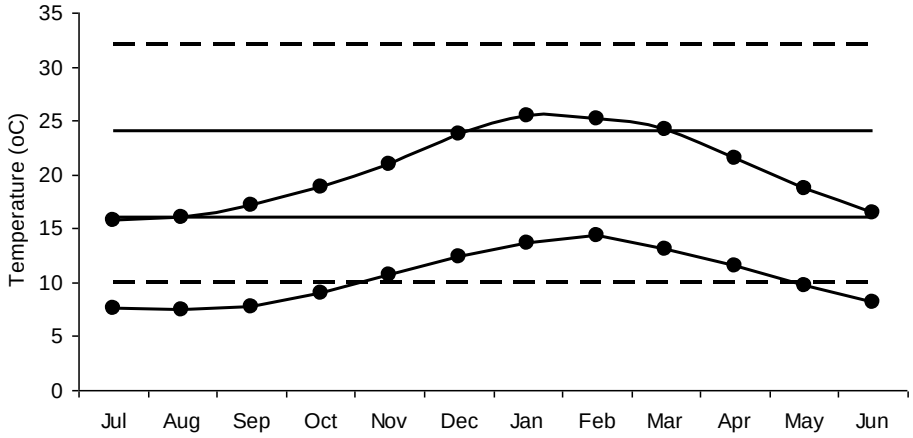
Albany

Lat.34o 57' S Long.117o 48' E Alt. 71m

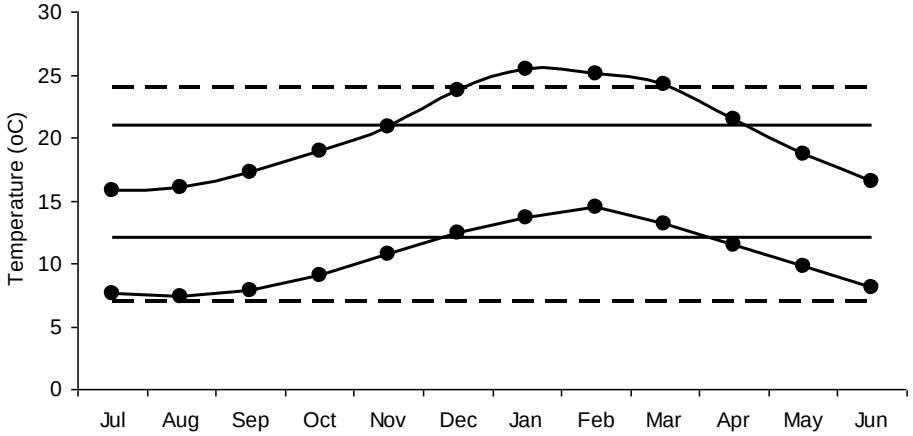
Spinach



European Wild Rocket



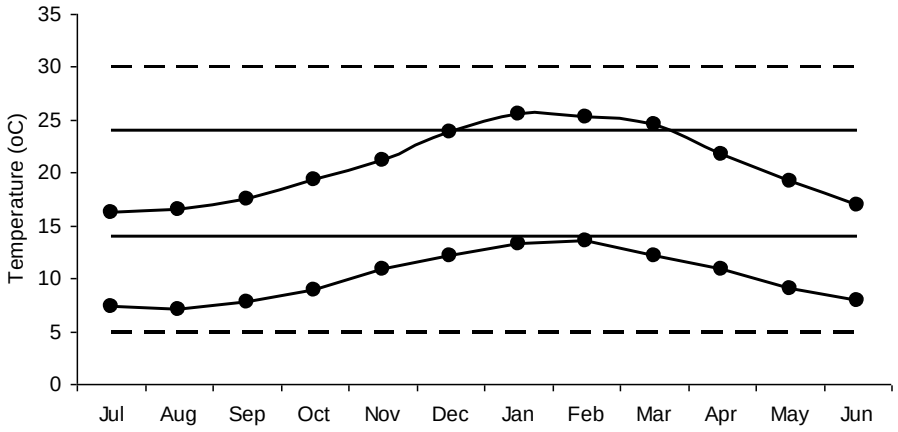
Lettuce



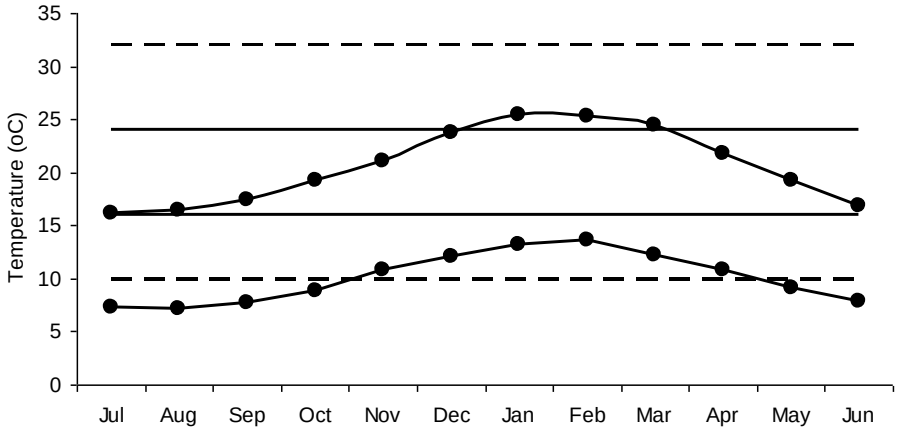
Denmark

Lat.34o 57' S Long.117o 22' E Alt. 18m

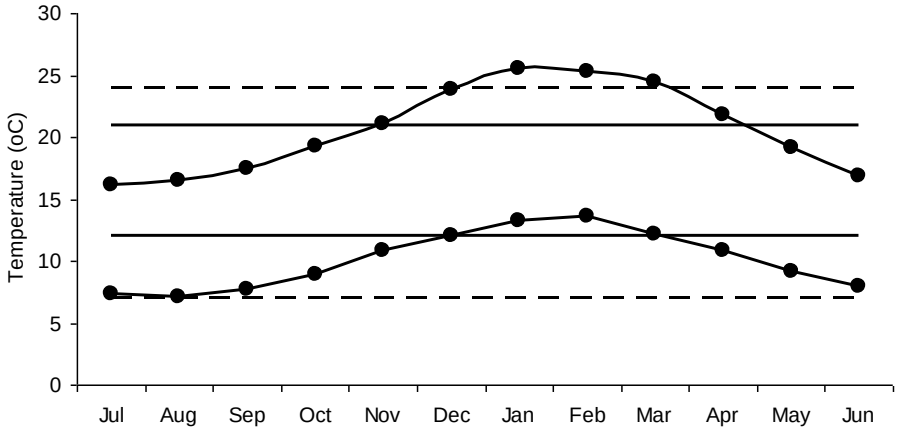
Spinach



European Wild Rocket

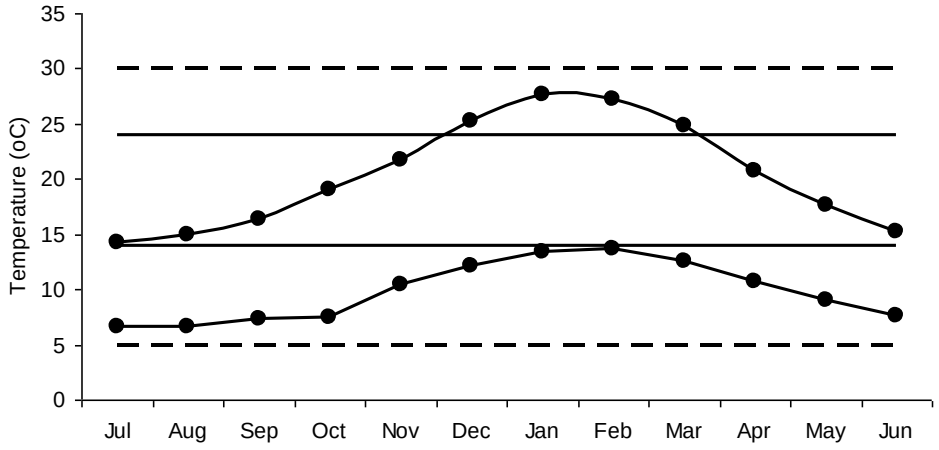


Lettuce

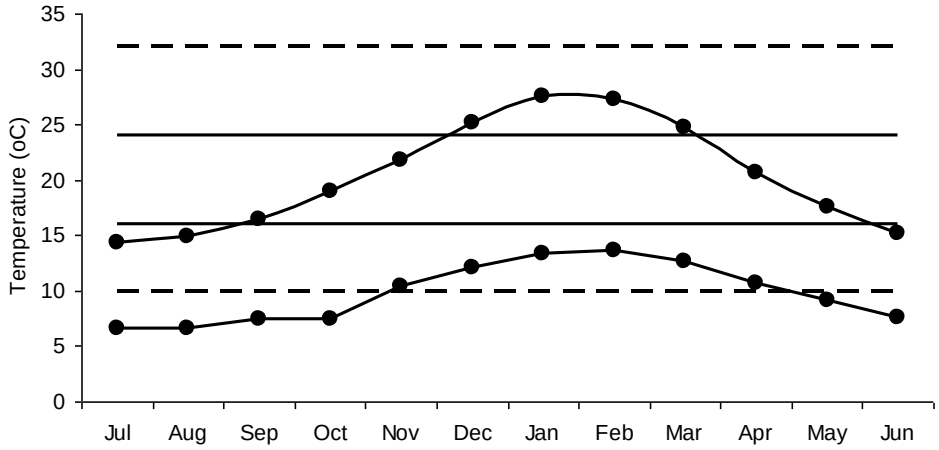


Manjimup

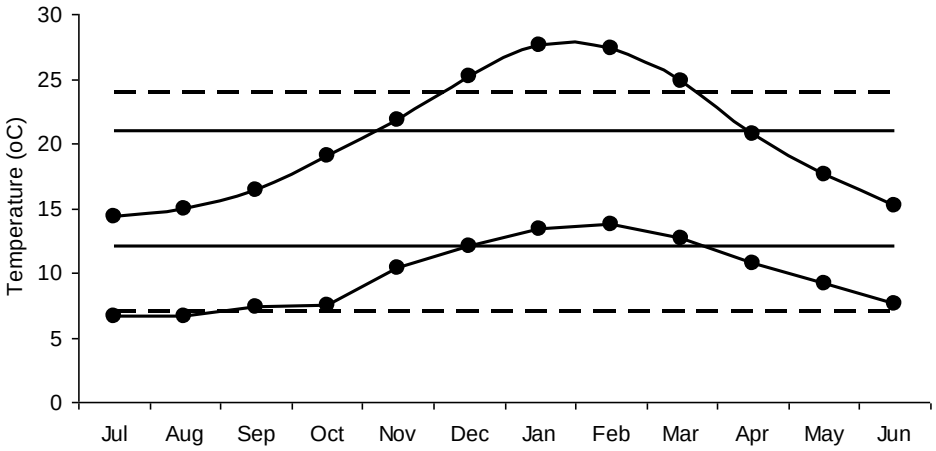
Spinach



European Wild Rocket



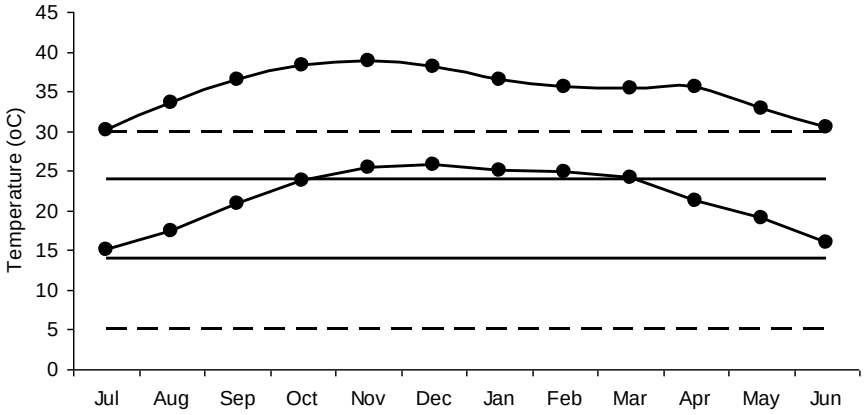
Lettuce



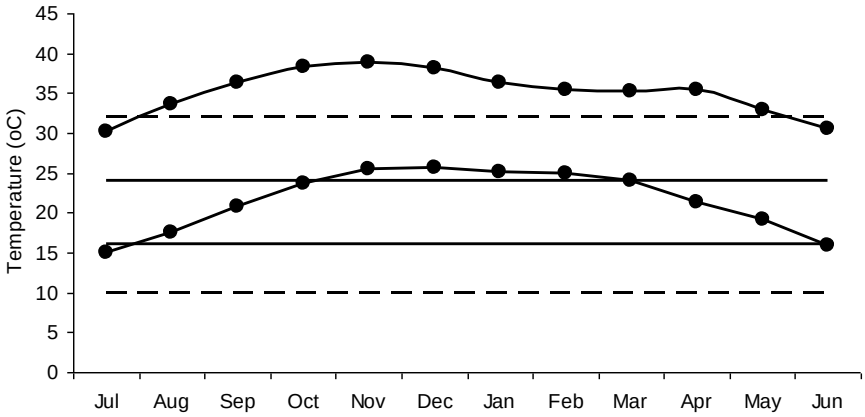
Kununurra

Elevation: 47 m

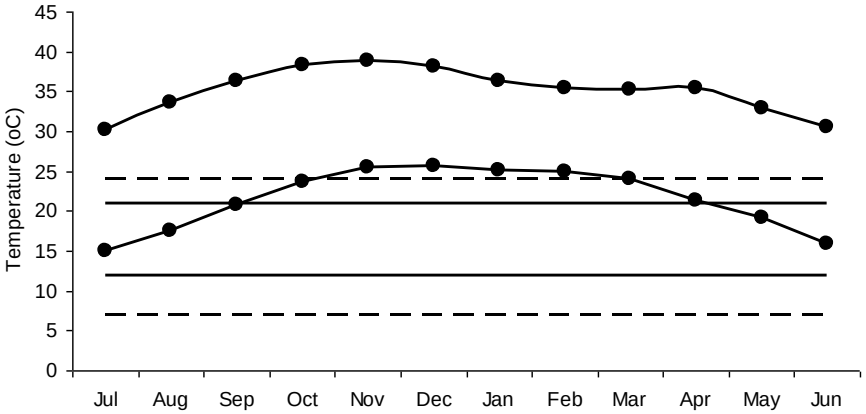
Spinach



European Wild Rocket



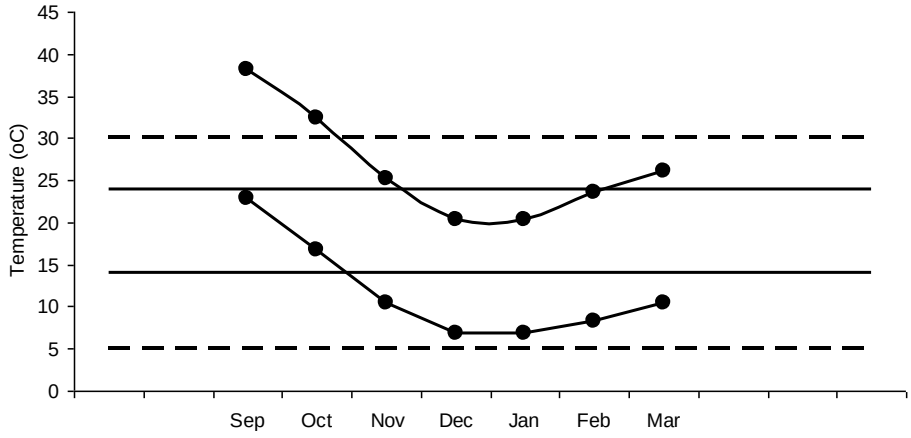
Lettuce



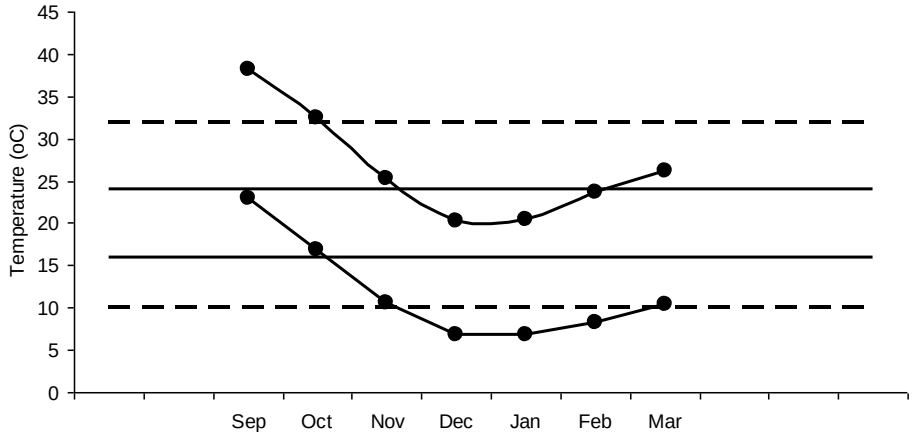
USA

Yuma, AZ

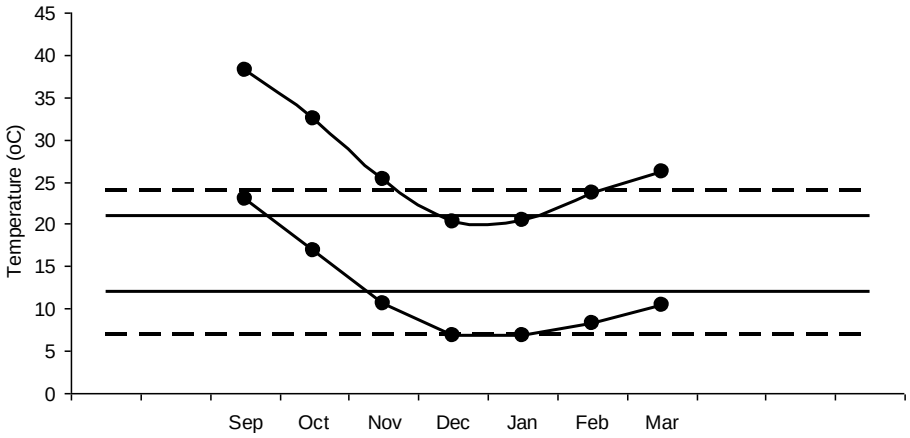
Spinach



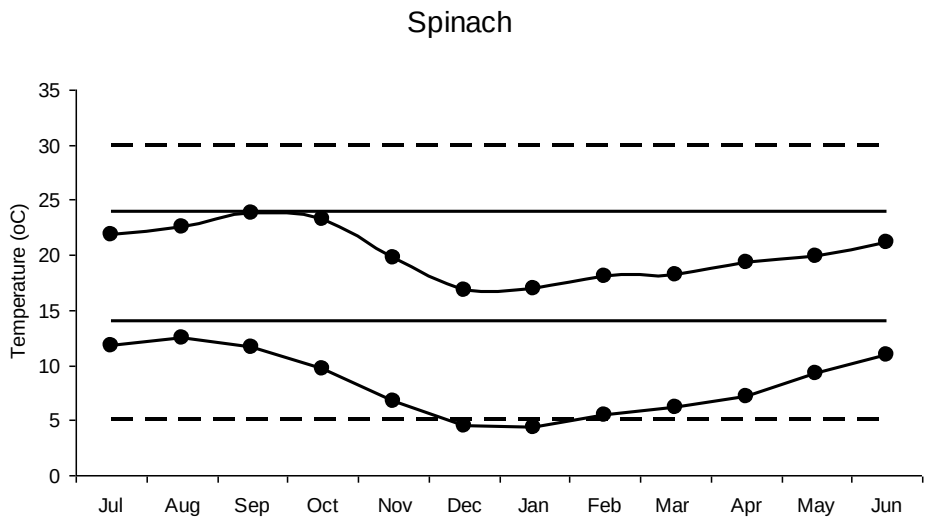
European Wild Rocket

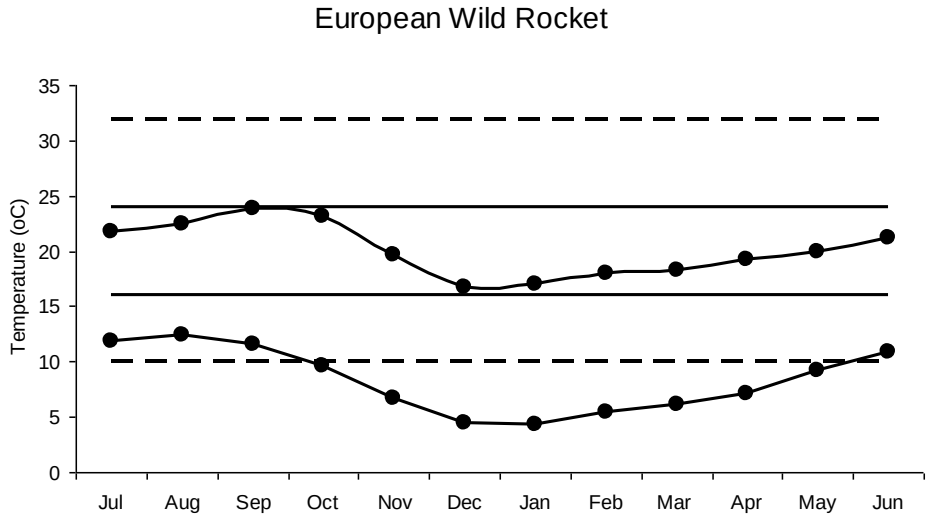


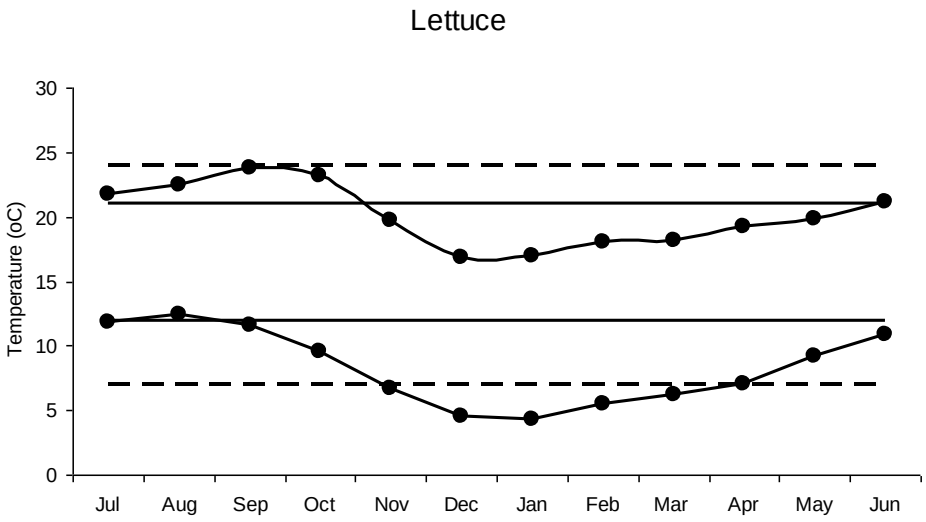
Lettuce



Salinas, CA


Spinach
Temperature (oC)
35
30
25
20
15
10
5
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun


European Wild Rocket
Temperature (oC)
35
30
25
20
15
10
5
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun


Lettuce
Temperature (oC)
30
25
20
15
10
5
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun

Appendix 7 – Plant & Equipment Purchases for New Block Set Up

Quantity	Item	Description	why
1	Furniture allowance	Tables desks chairs for office	Farm manager and general office set up
1	Site signage	Site Signage	OH&S and Corporate mktg requirement
1	Building pad/roadworks	Roadways	for around the paddock and headlands. Trucks coming and going etc
1	Gravel set down areas	Gravel set down areas	For vehicle wash down
1	Quick hitch	Quick hitch	to save time switching between different attachments
1	Tractor 4 Harvest	Tractor	Tractor for iceberg harvesting
1	Transplanter (High Density)	Drum Planter	Drum planter for planting transplants
1	Computer, fax, mobile etc	Computer, fax, mobile etc	for FM
1	Gator	Gator	for seed transport etc
1	Harvest Aid - Iceberg	Harvest Aid - Iceberg	harvesting iceberg - 2nd hand
1	Spray Unit / Irragation Lines	Spray Unit / Irragation Lines	spray unit for spraying irrigation lines for weeds
1	Scope/Blade	Scope/Blade	for roadway and headland clean up and soil displacement
1	Spray tank x 2	Spray tank	Spray tank for spraying and fertigation
1	Truck and Trailer	Truck and Trailer	transport between farm and cool room
1	Poly spinner	Poly spinner	Irrigation set up - laying laterals
1	Fertigation system	Fertigation system	for safe and effective fertigation prep and mixing
1	Hydraulic control	Hydraulic control	for irrigation. This saves people coming in to turn pumps on etc
1	Irrigation system - pumps etc	Irrigation system - pumps etc	irrigation set up
1	Soil moisture probes	Soil moisture probes	for effective nutrition management
1	Vehicle washdown points	Vehicle washdown points	Vehicle and equipment washdown points
1	Vehicle	FM vehicle	Vehicle for Farm Manager
1	Bore Establishment	Bore Establishment cost	New bore on block
1	Forklift	Forklift	Forklift for loading pallets on farm into truck
1	Scales	Scales	Weighing despatch product