ORCHARD MANAGEMENT

Managing the climate, dealing with climate variability and the successful management of climate risk are recognised as a definitive characteristic of farming excellence. BUT the past climate is no longer a reliable indicator of the future climate.

The climate is changing, and more change seems likely resulting in an impact on the productivity and location of chestnut production. This may interact with other key factors including disease.

There may be opportunities for some reductions in net greenhouse gas emissions through the way the industry operates.

Understanding the above can help position individuals and industry to benefit by positioning chestnuts as an important diversification option.

Six impacts of climate change on high value horticulture:

1. Change in mean temperature: faster crop development, higher water use and changed pest and disease risk. Crop chilling requirement
2. Changes to extreme max temperatures - heatwaves
3. Changes to frost risk
4. Changes to amount and timing of rainfall influencing soil water (and disease...)
5. Changes to quality and quantity of water available for irrigation
6. Change to carbon dioxide in the atmosphere

Some key questions growers should consider in planning their future production:

- How is climate likely to change in your region in coming decades, by 2030, 2050 and 2070?
- What are the most important impacts of these changes in climate on chestnut production in your region?
- How confident are you about your assessment on the climate change projections for your region? What information is missing? Are there more recent sources of information?

CLIMATE FOR CHESTNUTS:

Chestnuts grow best in areas with cool to cold winters, warm to hot summers.

and moderate to high rainfall, preferably with a substantial summer component.

Maximum temperatures of 25 to 30°C are needed to ripen the nuts.

Rainfall

In Australia chestnuts are grown mostly where rainfall is around 750 to 1500 millimetres/year. Such areas usually have some summer rainfall, but irrigation can be used as a supplement (see Irrigation). Rainfalls reported for other countries vary from 800 millimetres/year to 2000 millimetres/year. (*Gomes-Laranjo et al. 2012*) but may go as low as 500 millimetres/year.

Some challenges in relation to rainfall include:

- The location of the 750-1000mm growing areas is likely to change, favouring the currently higher-rainfall areas and likely to correspond with higher altitude areas, but suitable soils etc. may limit options;
- Potentially increased rainfall variability may be challenging especially during the mid-summer to autumn period;
- Increased need for irrigation but prospects are for reducing agricultural irrigation water availability (institutional changes as well as climate change);
- Selection for drought-resistance.

Drought Tolerance

The prolonged drought in Victoria and other parts of Australia during the early 2000s illustrated chestnut trees' resistance to drought. Rates of tree loss were very low, but chestnut crops were substantially reduced where irrigation was not available. At Beechworth in 2006 rainfall was only 43% (413 millimetres) of the long-term average (955 millimetres/year); in each of the following 3 years it was about 80% of the long-term average.

Temperature

Some challenges in relation to temperature include:

- Higher temperatures will tend to push nut growing locations to the higher end of the 300 to 1000m current range;
- Higher temperatures may result in suppressing yield;
- Frost risk may increase;
- Pollination enhanced with warmer, drier, lower humidity conditions;
- Possibly altered synchrony of pollination for different varieties - affecting xenia (the effect of pollen on seeds and fruit of the fertilized plant);
- Potentially earlier harvests;
- Positive implications in some environments.

Chilling Requirement

Deciduous trees need a period of cool temperatures to break dormancy and start spring growth. Inadequate chilling causes poor cropping. There are a number of ways to measure chill units, one of which is the specific number of cumulative hours of temperatures lower than 7.2 °C. For chestnuts the chilling requirement is estimated to be 300 to 400 hours (Stanford University n.d.); this is the equivalent of 2 to 3 weeks of chilling if the exposure to temperatures below 7.2 °C is continuous.

Cold Tolerance

Chestnut trees exhibit remarkable freezing tolerance (*Lopez-Matas et al. 2004*).

Frosts and snow conditions in areas where chestnuts have been planted in Australia have not caused ongoing concern. Late frosts can cause damage to young leaves or swelling buds and can substantially reduce yields.

Heat Tolerance

Chestnuts have reasonable tolerance to heat. Maximum temperatures of over 40°C are expected for several days in most summers in many Australian growing areas.

Wind and Sun Protection

Wind is generally not a concern for chestnuts in Australia. After top grafting, pruning is needed to limit the early growth and sail areas of the canopy until the graft union strengthens. Trunks are often painted in Australia to protect the bark from sun scald.

Altitude

In Australia, chestnut-growing areas are generally 300 to 800 metres above sea level but can be up to 1000 metres. In Europe, chestnuts are grown from sea level to 2000 metres (*Gomes-Laranjo et al. 2012*).

DISEASES:

Climate change may result in some of the following:

- **Chestnut blight -** potential increased risk with increased climate stress.
- ***Phytophthora* -** potential increased risk with episodic wetting-drying extremes increasing.
- ***Gnomoniopsis* -** potential decreased risk with drying and warming autumns.
- ***Verticillium* wilt -** potential increased risk with more droughts.

Climate and Disease Occurrence

The Chestnut industry has seen some climatic conditions that may be influencing the occurrence of specific pests and/or diseases.

A recent assessment of the 2016 and 2017 climatic conditions and how they may have related to Nut Rot was made by the Chestnut R&D Committee.

As part of the discussion Dave McIntyre gave an assessment of the climatic conditions of the past two seasons:

2015/16 - High Nut Rot Year

- Warmest October (2015)
- Big rains at flowering - 35 to 40 ml
- Rain consistent in January (2016)
- Hot harvest period - nuts drying on the ground - low humidity
- Tree stress through heat

2016/17 - Low Nut Rot Year

- Wet Winter and Spring
- December rain (2016)
- Rest of spring cool - no warm periods from flowering to harvest
- Orchards dried out - cool summer
- Cool autumn and dew on the ground / trees
- No tree stress

The grower assessments were that temperature was more of an issue than rain and that warm temperature and high humidity produced a lot of rot.

HARVEST AND POST-HARVEST:

Climate change may result in some of the following:

- Warm and humid conditions increase fungal infections (including *Gnomoniopsis*). One possibility is that the reduction in humidity may improve conditions
- Hotter weather increasing pressure for best-practice harvest practice including:
  - regular harvest (reduce desiccation, reduce fungal risk)
  - rapid (but not too rapid) cooling
- Hail risk may increase slightly

TOOLS:

Weather Stations

Weather information should be a 'tool' that growers monitor and make assessments of the conditions to assist in making orchard management decisions.

There are a number of weather station networks available to growers and they include:

Bureau of Meteorology:
http://www.bom.gov.au/climate/data/stations/about-weather-station-data.shtml

Lower Murray Water:
http://www.lmwweatherstations.vic.gov.au/

NSW DPI:
https://www.dpi.nsw.gov.au/agriculture/horticulture/grapes/weather-stations-network/wsn

North East Catchment Management Authority:
http://www.necma.vic.gov.au/Solutions/Sustainable-Agriculture/Weather-Stations

Riverine Plains Inc:
https://riverineplains.org.au/home/weather-station-network/

South Australian Murray-Darling Basin Natural Resources Management Board:
http://www.naturalresources.sa.gov.au/samurraydarling-basin/publications/automatic-weather-station

TAFCO:
http://weather.tafco.com.au/

Crop Calendar:

The South Australian Research and Development Institute, back in 2010, developed a Crop Calendar to identify key climate and weather risks for horticulture production.

As part of the process was for SARDI and an industry party to identify the key risks in the current climate before discussing any impacts of a changing climate.

A crop calendar is a first step in linking what happens in the orchard with weather and climate information.

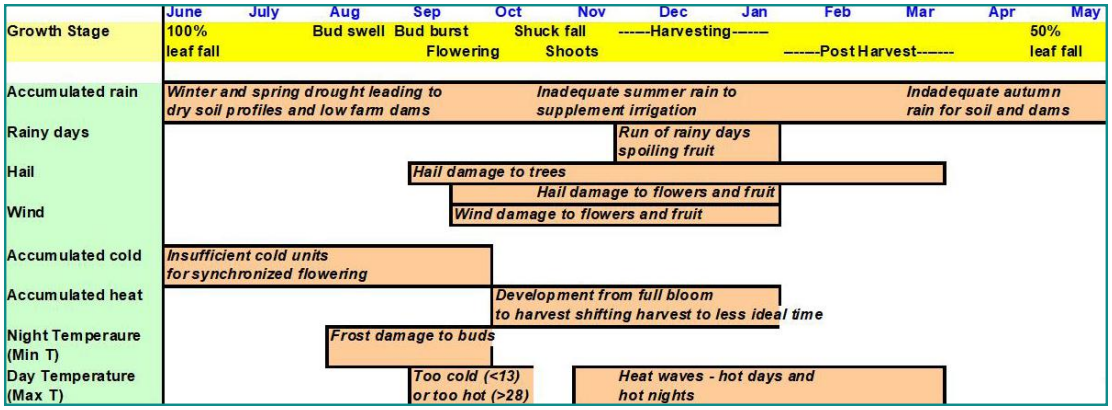

Figure 1: Example of crop calendar - developed with the Australian Cherry Industry.

References:

Weather and climate: information, challenges and opportunities for the chestnut industry - CSIRO Climate Adaptation Flagship, Dr Mark Howden

Australian Chestnut Growers' Handbook - Chestnuts Australia Inc. 2013.

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