Adapting the horticulture industries to climate change

Introduction

New Zealand's horticulture export revenue is primarily from apples, kiwifruit and wine. The production of these crops and commercial vegetable production is being, and will continue to be, subjected to a changing climate. Changes to the average temperatures and extreme temperatures, the timing and amount of rainfall, and levels of atmospheric greenhouse gases are likely to impact on the management and production outputs of horticultural crops.

Impacts of a changing climate

The anticipated impacts of climate change for the main fruit crops are positive with yields, fruit size and quantity not expected to be compromised. The risk of frost damage is not expected to increase but the use of water and pressure from pests and disease are likely to be greater. More extreme weather events such as high temperatures and increased storm damage will pose a risk to production.

Seasonal Temperature Profiles

The impacts of changes to the temperature profiles across the season and in different regions are complex but do not consistently result in negative or positive changes to production (Table 1)

Changes to average temperature are expected to impact on the winter chilling requirement to break winter dormancy of deciduous woody fruit trees and vines which will result in poorer fruit quality and lower yields, which in turn might result in changes to production costs and profits.

Table 1: Summary of climate change impacts for the main horticultural industries in NZ (↑increase, ↓ decrease)

	Apples	***Grapes***	***Kiwifruit***
Temperature			
Temperature means ↑	Yield ↑ Quality ↑ Disease risk ↑ Sunburn ↑	Yield ↑ Quality ↑ Disease risk ↑	Yield ↓ Quality ↑ (and ↓) Disease risk ↑
Temperature extremes Frost ↓ Heatwaves ↑	Frost damage ↓	Frost damage ↓	Frost damage ↓
CO_2 ↑	Biomass ↑	Biomass ↑	Biomass ↑
Rainfall variability↑↓	Irrigation ↑	Irrigation ↑ Drought risk ↑	Irrigation ↑
Water quality	Leachate load ↓	Leachate load ↓	Leachate load ↓
Extreme events Hail ~ Wind ~	Damage to fruit ~ Damage to trees ~	Damage to fruit ~ Damage to vines ~	Damage to fruit ~ Damage to vines ~
Combined impacts ~	↑ unless pest & disease impacts override	↑ unless pest & disease impacts override	↑↓

The seasonal pattern of temperature affects the timing of bud break, flowering and harvest for fruit crops. Higher summer temperatures affect tree and vine crops differently. Apple fruit size will increase with higher summer temperatures, but grapes and kiwifruit will convert the extra energy into vegetative growth and produce small sour fruit.

There are expected to be trade-offs in plant responses and costs. For example, the current costs of chemical and hand thinning of apple flowers might be reduced because of the lack of winter chilling. Warmer temperatures during fruit development might result in larger fruit sizes, but more risk of sunburn damage.

There is predicted to be larger areas in New Zealand that are free from spring and autumn frosts. There also might be fewer frosts in other areas and an increase in the growing period. This could result in an expansion of the economic production of horticulture species and varieties into new areas.

Rainfall - Precipitation

In general, the western side of the country is expected to get wetter and eastern regions are expected to become drier, but the timing and intensity of the precipitation events is likely to be less predictable. The two main consequences of the changes to rainfall patterns are changes to irrigation needs and to ground water recharge as a result of changes to drainage patterns. Since crops like grapes are usually grown in the dry eastern regions of New Zealand, the water requirements for irrigation and frost protection are likely to coincide with decreasing rainfall and groundwater reserves. The timing of when rainfall occurs during the growing season can influence the fruit maturation rates, the quality of the fruit and the overall yields of crops. It is difficult to assess the changing pattern of hail in the future, but similarly, the timing of hail events can have serious impact on the profitability of horticulture crops because flowers and fruit are very vulnerable to damage by hail.

Increasing levels of Carbon dioxide (CO_2)

The prime impact of rising CO_2 levels on plants is to increase the biomass produced. The focus of horticultural crops is on producing flowers and fruit, therefore the balance of vegetative and reproductive growth is important to these industries. In studies of plants growing in a CO_2 enriched atmosphere the types of responses were different depending on species. Some the differences measured included the length of flowering time or amount of fine roots produced or branching patterns of the plants.

Adaptation

Adaptions to the impacts of climate change can be assessed on different scales, tactical, strategic and transformational.

Tactical adaption

The tactical adaptions for the three fruit crops are related to day-to-day husbandry techniques. Modification to the current system and practices relating to the types of chemicals used, pruning regimes

or irrigation are suggested for managing the changing climate. In particular, summer vegetative growth can be controlled to favour reproductive growth by:

- **Winter pruning:** The balance of number and types of buds can be changed to increase reproduction growth in the next growing season. Also for vines, selecting thinner canes will reduce summer vegetative growth.
- **Summer pruning:** Grape vines are mechanically pruned and Kiwifruit cranes are pruned back to the last fruit on the shoot to suppress vegetative growth. Although a second pruning in summer creates additional labour costs, these practices may be required more in the future.
- **Girdling vines:** Kiwifruit vines are ring-barked (girdled) to disrupt the flow of carbohydrates from the canopy to the roots to create bigger fruit. Girdling techniques may be considered for the management of vegetation growth in other woody fruit crops in the future.

Growers are more likely to face trade-offs between pruning to manage the risks of sunburnt fruit during high temperature events and pruning to reduce vegetative growth in the summer. Flower and fruit thinning can be carried out in favour of shaded positions on the trees and vines.

Strategic adaption

Investment in new infrastructure or cultivars involves a greater level of managerial adjustment, decision making, planning and resources. The suggested strategic adaptions tend to be directed towards managing extreme weather events.

- The use of multi-purpose overhead netting protects against a range of risks including sunburnt fruit and also damage from frost and hail. The installation of overhead netting is already occurring and is more likely to be needed in the future.
- More shelter may be needed to protect against strong winds.
- Even though fewer frost events are anticipated, overhead sprinklers may be employed to manage late frosts which impact on the growing season.
- Irrigation needs and the installation of new infrastructure are likely to increase in the future. New irrigation schemes are being mooted around New Zealand, particularly in the eastern and northern regions.
- Water storage is proposed for irrigation water in the Central Hawkes Bay, Wairarapa and North Canterbury.

Transformation adaptation

Significant changes to business might occur if the existing crops become unviable in the future. Businesses might be compelled to introduce new crops on the same land or the business might relocate to another region to grow the same crop.

New horticulture areas may include areas such as the Mamaku Plateau near Rotorua, the Ruataniwha basin in the central Hawke's Bay in the North Island or the Hakatrarmea and Maniototo valleys in the South Island.

Summary

The horticulture industry is nimble and capable of undergoing change on a range of time and management scales. The strategies employed for responding to economic opportunities are likely to apply in similar way to need to respond to changes in the climate.

Further Information

The full paper that is this summary is based on is: *Adapting the horticultural and vegetable industries to climate change.* (July 2012) B. Clothier, A. Hall, S. Green. In: Impacts of Climate Change on Land-based Sectors and Adaptation Options. Technical Report to the Sustainable Land Management and Climate Change Adaptation Technical Working Group. Ministry of Primary Industries. Chapter 6. Pp 241-289. www.climatecloud.co.nz/CloudLibrary/2012-33-CC-Impacts-Adaptation_SLMACC-Chapter6.pdf