Climate change impacts on plant diseases affecting New Zealand horticulture

Image from: https://en.wikipedia.org/wiki

Plant diseases, which are a major constraint on New Zealand's horticultural production, are likely to be affected by temperature and rainfall changes resulting from global climate warming.

In 2011, horticultural exports were valued at NZ$3.5B, with wine (NZ$1.1B), kiwifruit (NZ$0.9B) and apples (NZ$0.4B) being the largest components. The value of horticultural exports has approximately doubled over the last 10 years and several industry sectors are making plans for further substantial growth during the next 10-20 years.

Climate change predications for New Zealand

It is estimated that New Zealand will experience an average 1^{o}C rise in temperature by 2040 and a 2^{o}C rise by 2090. Lower and upper limits across New Zealand range from 0.2 to 2.0^{o}C by 2040 and 0.7-5.1^{o}C by 2090. There is expected to be increased frequency of westerly winds during winter and spring, bringing higher rainfall to western parts of the North and South Islands and lower rainfall to eastern and northern regions. Westerly wind frequency is expected to decrease during summer and autumn, bringing lower rainfall to the west of the North Island and higher rainfall to Gisborne and Hawkes Bay. Average predicted changes in temperature and precipitation indicate that most of New Zealand's eastern horticultural regions will become warmer and drier during the 21st century.

How will climate change affect plant diseases in New Zealand?

The most important environmental factor affecting plant diseases is rainfall. Projected changes in average annual rainfall across New Zealand generally indicate increases in the west (up to 5% by 2040 and 10% by 2090) and decreases in the east and north (exceeding 5% in places by 2090) (Figure 1). Heavier and/or more frequent extreme rainfalls are also expected, especially in places where mean annual rainfall is predicted to increase.

Although areas with higher rainfall generally have higher disease risk, the weather variable that most affects plant disease development is the duration of surface wetness. Increased average temperature will also likely increase disease risk.

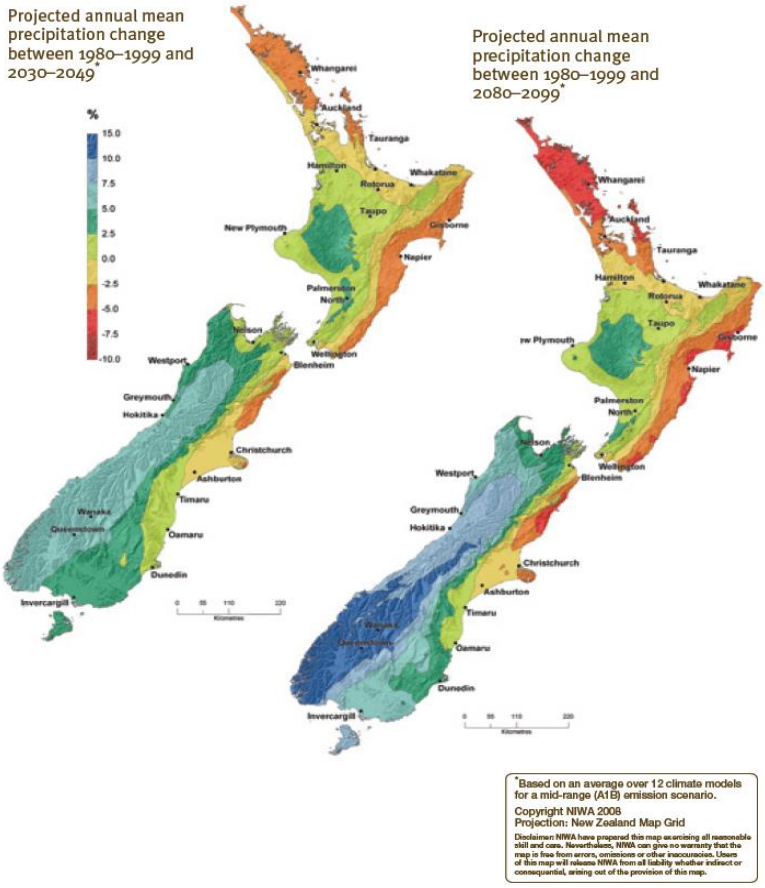

Figure 1: Projected mid-range changes in annual mean rainfall (in %) relative to 1990

Disease risk under changing climate patterns

This study examined four plant diseases and the likely impacts of climate change predictions on these four diseases.

Apple black spot

Increases in both temperature and rainfall in Nelson, Hawkes Bay and Central Otago will likely cause an increase in black spot risk. For the worst case 2090 prediction, the greatest disease risk increase will occur in Nelson (4.4%). The increase in risk in Central Otago (2.1%) will give similar risk to that in which occurs now in Hawkes Bay.

These predicted changes in climate are unlikely to have a large impact on requirements for black spot control, assuming effective fungicides continue to be available, because frequent fungicide spraying already occurs in all regions.

Image from:http://en.wikipedia.org/wiki/Apple_scab

Grapevine downy mildew

The current regional rankings of grapevine downy mildew risk for Gisborne, Hawkes Bay, Marlborough, Canterbury and Otago are likely to vary only slightly in response to the various climate change predictions. Increases in temperature and rainfall will cause an increase in downy mildew risk.

The greatest increase in risk will occur in Canterbury and Central Otago. In these two regions, the amount of fungicide spraying will have to be increased to that currently used in Gisborne.

Image from: http://en.wikipedia.org/wiki/Downy_mildew

Onion downy mildew

Currently, onion downy mildew risk is greater in Auckland and Waikato than in Canterbury.

Increased temperature is likely to cause negligible change in downy mildew risk. However, definite conclusions about the effect of climate change on onion downy mildew could not be drawn in this study.


Image from: http://www.ipmimages.org/browse/detail.

Kiwifruit bacterial canker (Psa)

The study found that the current regional rankings of Psa risk for Northland, Bay of Plenty and Nelson will remain the same under most climate change predictions.

The main difference in the Psa risk pattern, compared to the above three diseases, is that increased temperature will cause Psa risk to decrease, especially in North Island regions. This is because warmer spring and summer temperatures will likely be above the optimum for infection.

However, given that future rainfall variability is expected to increase more in areas with an increase in average rainfall (more frequent extreme events), the major impact of climate change is likely to be greater fluctuation in disease from year to year, rather than an increase in average disease risk in a given region.


Psa leaf spotting and an infected vine


Images from: http://www.biosecurity.govt.nz/pests/kiwifruit-vine-disease

Timeframes for horticultural adaptation

The disease risk changes predicted in this study were quite small, even for the worst case upper limit climate predictions. Uncertainty in predicted rainfall, the main driver of disease, makes it challenging to recommend adaptation strategies. For example, if Central Otago experienced an increase in disease risk that was significant by 2090, how should the pipfruit and wine sectors and regional council respond? Given that the effects of the predicted trend would be hardly noticeable for another 40-80 years, and that other climate change scenarios might result in contradictory predictions in relation to plant disease risk, there is little pre-emptive action that can be taken within the next 10-20 years.

The 40-80 year timeframe for the predicted changes in climate to become important is long in relation to the rate at which horticultural industries have adapted in the past to changing regional production and market factors, e.g. new cultivars, new production systems and new market niches for specialist horticultural products. Unless climate change causes more catastrophic changes than those predicted, it seems unlikely that New Zealand horticulture will have difficulty adapting to changes in plant disease risk.

Further Information

The full technical report, *Climate change impacts on plants diseases affecting New Zealand horticulture* can be downloaded at www.climatecloud.co.nz/CloudLibrary/2013-03-cc%20impacts%20on%20plant%20diseases%20affecting%20NZ%20hort.pdf

The following article provides further information for horticulturalists:
Impacts of climate change on horticulture.
http://www.landlearnnsw.org.au/sustainability/climatechange/agriculture/horticulture/impacts