Rethinking fire spread and behaviour

• Fire scientist Grant Pearce collecting fire behaviour video footage from an in-fire camera.

THE number of high risk fire days in New Zealand is predicted to increase with climate change and more intense and difficult-to-control fires are expected to become more common.

To identify, mitigate and adapt to future fire threat, the New Zealand Government is funding a five year Extreme Fire research programme (2016-2021) led by Scion's Rural Fire team in collaboration with other New Zealand experts and international fire scientists.

The research programme's overall aim is to increase understanding of extreme fire, and develop new ways to predict, prevent and fight such fires. One of the major research areas is a re-examination of the way fire spreads.

Traditional models of wildfire heat transfer and fire spread assume a steady, evenly spreading flame front that radiates most of the heat ahead of the fire to unburnt fuels says Grant Pearce, fire scientist.

"We are testing a new theory that heat at the fire front is transferred by turbulent convection," he said.

"The theory is that as hot air rises (convection), cold air sweeps in behind that and the fire's flames effectively are pushed forward into the fuel, causing a series of peaks and troughs within the burning flame front.

"The taller flame peaks occur in areas where the air is rising and pulling the flame upward, and the troughs formed by the cold air circulating down. These cause the flames to be pushed out ahead, where they can directly ignite fuel."

The theory has been proposed by the U.S. Forest Service's Missoula Fire Science Laboratory and tested in laboratory conditions there.

"Here in New Zealand, we are carrying out experimental burns using in-fire temperature and wind sensors and high-speed thermal imaging," Mr Pearce said.

Experimental burns were carried out in stubble fields in summer 2018 and 2019. Each of the stubble burn plots were about 2-4 hectares and the evenly spaced crop rows and uniform stubble height mimicked laboratory fuel conditions. The burn results supported the new theory on fire progress. "What they saw in the lab, we saw in the field," says Grant.

The team plans to continue their work in heavier, more complex vegetation, such as gorse and wilding pine plots. Introduced gorse is a ubiquitous pest plant in New Zealand and mature plants plus fallen needles can add up to a very high fuel load. Wilding pines, or weed conifers, can form dense thickets that also have a very high fuel load.

The new fire spread model will be help New Zealand adapt and respond to the threat of extreme fires. Being able to predict extreme fire behaviour will assist rural fire managers to assess risk, predict the spread of fires, implement control measures and improve the safety of firefighters and the public.

Scion is a Government-funded research institute that specialises in research supporting New Zealand's forestry, wood products and biomaterial sectors. The Rural Fire Research group, established in 1992, focuses on developing develop the science and technology needed to protect life and property, and manage fire in the landscape.

See www.ruralfireresearch.co.nz for more information.