Knowing when frost strikes is key to avoiding total crop losses

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Close up of a frost damaged wheat head showing lack of growth and pale colour

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In-paddock temperature measurement could assist grain growers in determining whether their crops have been subjected to frost, therefore enabling them to quickly activate strategies to salvage a return from affected crops.

Temperature monitoring within a paddock in frost-prone areas is seen as an important tool, yet very few growers measure temperature at the susceptible parts of their property, according to Agrilink Agricultural Consultants principal consultant Mick Faulkner.

Mr Faulkner, who is part of the Grains Research and Development Corporation (GRDC) National Frost Initiative (NFI) project, “Spatial temperature measurement and mapping tools to assist growers, advisors and extension specialists manage frost risk at farm scale”, says growers should consider using temperature loggers to more accurately identify when low temperatures occur.

> “Until now, frost identification has often been registered by the presence of ice at or after dawn, at ground level near the farm residence,” Mr Faulkner says. “But this may not reflect the actual temperatures at the susceptible parts of a paddock where crops are being grown.

“Often frosts that have occurred earlier in the night but have cleared by dawn are missed, and frosts that caused ice on lawns are assumed to have had a similar effect in paddocks but that may not necessarily be the case.”

Temperature monitoring equipment, such as Tiny Tags, iButtons and weather stations, are currently commercially available and can help inform growers’ frost mitigation strategies and enable them to accumulate data over numerous seasons to develop farm frost incidence and severity maps.

Such equipment is recommended as part of an integrated management plan to enable growers to build their knowledge base of their properties to mitigate the impacts of frost, a central focus of the GRDC’s NFI, of which the spatial temperature measurement and mapping tools project being led by Steven Crimp from CSIRO is a major contributor.

Mr Faulkner says temperature loggers should be situated at or just above the canopy height and raised every week or so during the growing season to account for crop development, particularly when the head is emerging (booting to milk development or Growth Stage 40-80).

> “As this is the most sensitive stage for the plant, accurately measuring temperature experienced by the head is most critical at this stage.”

Where possible, monitoring should be done in a number of locations that take into account differing factors that influence frost impact, such as varying landscape gradients (on the flat, break of slope and a short distance up a slope in areas affected by cold-air drainage) and soil types (particularly from darker loamy soils to lighter sandy soils).

While this is the most accurate method to collect data on the temperature the plant has been exposed to and likelihood for frost damage, data from sites further away, such as fence lines or other weather stations on the property, may still be useful.

Mr Faulkner, who is also a member of the GRDC’s Southern Regional Cropping Solutions Network, says using data from the closest Bureau of Meteorology site to determine farm temperature may be valid for some farms but is usually inadequate for most.

As part of the NFI project, in which Agrilink is involved, temperature loggers have been installed at trial locations in the Mid North of South Australia as well as at a number of on-farm monitoring sites for the past two years. The results indicate minimum temperatures between the BOM sites (1.2 metres above bare ground) and the height of the crop fluctuate significantly and there is greater variability in temperature in spring than winter.

Mr Faulkner says the time from frost damage occurring to identification is critical.

> “Identification of frost damage is important because it enables a grower or adviser to understand the impact of frost on yield and extent of the area of damage. Assessment provides information on financial exposure and immediate mitigation options which include cutting for hay or silage, and grazing a standing crop.”

Mr Faulkner advises that the parts of crops that should be inspected regularly include:

- Cereals – juvenile damage in high stubble loads; all internodes during stem elongation and the

reproductive period; the soft tissue above each node; the stem where the flag leaf attaches; whole heads during and after booting; anthers, stigmas, embryos and grain.
- Pulses – juvenile damage in high stubble loads; leaf death of lentils, stems of faba beans and lupins; bacterial blight of some pea cultivars; flower abortion; developing pulse pods; and grain inside pods.
- Canola – leaf damage in juvenile plants; stem splitting; flower abortion; developing pods; and grain in pods.

Through the NFI, consultants are researching sensors and other methods to more accurately identify damaged plant tissue or damaged parts of a paddock soon after frost events, which each year inflict an estimated average of $400 million in crop losses in Australia.

Since 1999, the GRDC has invested in more than 60 frost-related projects. As of 2014, investment in frost research increased to $4 million a year through the five-year NFI. The initiative aims to deliver to growers a combination of genetic and management solutions, along with tools and information to better predict, plan and manage frost events.

More information on frost management can be found in the GRDC Tips and Tactics publication for Managing Frost Risk, and via the via the GRDC's suite of GrowNotes™ publications.