# STUBBLE LIFTS FROST SEVERITY

## Tactical management of stubble loads in high-frost-risk areas could help mitigate the impact of frost on crop yields

By **Janet Paterson**

RESULTS FROM FROST trials in the Western Australian wheatbelt in 2012 and 2013 indicate that high stubble loads can increase the severity and duration of frost events.

New GRDC-funded research planned for 2014 will continue to investigate the relationship between stubble load and frost impact on crop yield.

Project leader Dr Ben Biddulph says stubble appears to insulate the soil surface, which lowers the amount of heat absorbed into the soil compared with paddocks without stubble.

"We also think less heat is radiated from the soil in stubble paddocks at night, which lowers the canopy temperature and leads to greater frost severity, duration and damage."

In a 2012 trial at Wickepin, WA, with the Facey Group, yields of Mace[ch] wheat were 0.7 tonnes per hectare higher in burnt stubble high in the landscape (where there was moderate frost risk) and 0.3t/ha higher in burnt stubble lower in the landscape where the frost risk is higher (Table 1).

"Wheat in the stubble sections appeared to have a higher frost-induced sterility than wheat on burnt stubble but we need to do more work to fully understand the relationship between stubble load, frost and yield loss," Dr Biddulph says.

Similar trials at Nyabing, WA, with the Nyabing Farm Improvement Group in 2013 showed significantly higher frost-induced sterility and almost non-existent yields on plots with high stubble loads (more than 3.5t/ha) following a severe frost on 10 October.

"Wheat in the high stubble plots had almost 85 per cent sterility, while plants beyond the stubble had 20 to 30 per cent sterility, indicating that the high stubble load increased the frost damage," Dr Biddulph says.

Temperature data showed substantially colder temperatures in plots with high stubble.

A yield map of the research trial exposed large 'edge effects' of stubble on yield, independent of elevation.

However, in the absence of frost, plots with low stubble loads had less biomass and lower yield potential than higher-stubble plots. □

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High stubble loads appear to increase frost damage by reducing the amount of heat radiated from the soil at night, leading to lower canopy temperatures and greater frost severity, duration and damage. New research planned for 2014 will further investigate the impact of stubble load on frost damage with the aim of developing stubble management guidelines for frost-prone areas.

**TABLE 1** Yield and yield component data for Nyabing. Where frost induced sterility (FIS), harvest index (HI) 100 grain weight (100GW) and screenings <2mm were measured. Values are the predicted means, n=3, estimated using linear mixed models.

| Position | Low landscape | | | High landscape | | |
|---|---|---|---|---|---|---|
| Stubble | Additional* | Standing | Removed | Standing | Removed | $LSD_{0.05}$ |
| Stubble biomass in August | 3.5 | 2.6 | 0.5 | 2.6 | 0.5 | 0.5 |
| Average minimum canopy temperature during September–October frosts | –2.4 | –2.0 | –1.8 | –1.1 | –1.3 | 0.16 |
| Hours below zero | 45 | 33 | 32 | 22 | 24 | |
| Yield (t/ha) | 0.6 | 1.0 | 1.8 | 1.9** | 2.5** | 0.40 |
| FIS (%) | 87 | 33 | 35 | 20 | 13 | 4.0 |
| Screenings (%) <2mm | 56 | 9 | 9 | 13 | 13 | 5.5 |

*Additional stubble plot was unreplicated and was only located low in the landscape.
**Yield estimated from small plot trial harvester cuts with two replicates per plot.

### PLANNED STUBBLE–FROST RESEARCH

A series of large-scale trials in 2014 will further investigate the impact of stubble on frost severity and duration. Precision agriculture equipment will be used to sow and harvest the trials to develop detailed yield maps of the trial sites. Following frost events, treatments at flowering stage will be tagged and monitored during grain fill for frost-induced sterility. Trials will cover the following topics.

**Stubble load:** Impact of stubble load on frost severity and duration.

**Stubble architecture:** Impact of standing versus horizontal stubble on frost severity and duration. Previous research indicates that standing stubble with small amounts of horizontal residue results in higher minimum soil temperatures (by about 0.8°C to 1°C) than low-cut stubble with more horizontal residue.

**Stubble and crop row orientation:** Sowing in an east-to-west direction results in more soil shading, but the effects on soil temperature and frost are largely unknown. This trial will determine whether sowing and stubble direction can be used to manipulate frost incidence and severity.

**Stubble composition and colour:** Soil colour is thought to have a significant effect on frost severity, with lighter-coloured soils generally more prone to frost events. This trial will examine whether stubble colour and composition also affects frost severity.

**Crop architecture:** This trial will compare 'skip row' seeding with conventional seeding to determine if wider rows enable more heat to be stored and released from the soil (less frost) and if they improve cold air drainage out of the canopy after a frost event.

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