

Agronomic practices – frost risk rankings table

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Take Home Messages

- Agronomic practices have proven to reduce frost damage.
- Clay delving reduced frost damage by up to 80 percent.

Introduction

The main strategy used to minimise frost risk in broadacre cropping has been to sow the crop later or at least stagger sowing times. However, manipulation of the soil heat bank to release heat and manipulation of canopy air flow have proven to be valuable agronomic options to reduce your risk of frost. They can be used in conjunction with, or instead of delaying sowing.

Research showed significant techniques that have reduced the impact of frost. Figure 1 shows the main principles behind our research, to manipulate the soil heat bank, to store heat during the day and release heat at night up through the canopy of the crop. We also endeavoured to look at how we could manipulate the canopy to allow for warm air from the soil to rise.

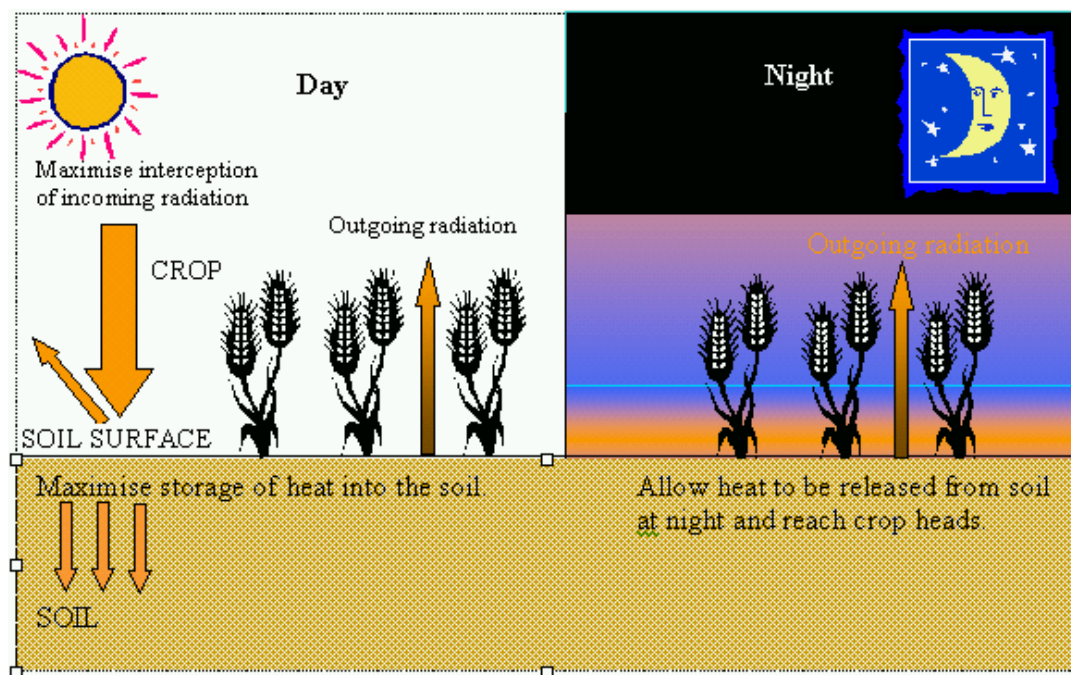


Figure 1 : Temperature dynamics in a crop canopy and canopy interactions.

The following series of tables that list the effect agronomic practices on frost risk in broadacre agriculture in southern Australia. The agronomic practices are about paddock tools that can be implemented once you have determined the frost risk of each paddock (Table 1). The frost avoidance strategies, like delaying sowing, are about whole farm tools (Table 2). Table 3 outlines frost tolerance strategies.

Table 1: Agronomic Strategies that reduce frost risk

Strategy	Description	Ave inc in temp at canopy height	Reduction in frost damage
Clay Delving	In sandy surfaced soils, clay delving increases nutrient availability, infiltration rate and heat storage. For more information on delving contact SARDI.	1°C	Up to 80 %
Rolling	Rolling sandy soil and loamy clay soil after seeding has reduced frost damage though we have not yet found results to be statistically significant.	0.5 °C	Up to 18%
Crop Architecture	A variety without large flag leaves allows a more open canopy and heat rise from the soil. Buckley was less frost damaged than Tameroid Durum.	0.5 °C	Up to 20 %
Variety Mix	In SA blending the two varieties, Krichauff and Yitpi questions the benefits of blending and suggests that a farm would seem to be better off growing a whole paddock of the one variety and a whole paddock of the other variety.	0	Yitpi 12% less damaged than Krichauff
Remove stubble	Our research showed that removing stubble had a negligible effect on yield and frost risk. The role stubble plays in retaining soil moisture is more important.	0.5°C	Minimal
Wide row spacing	We have found wide row sowing to be ineffective at minimising frost damage (eg 23-46cm spacings). Wide row crops consistently yield 10-15% less than the standard sowings with or without frost. In the presence of minor or severe frost damage the % damage remains the same for both treatments.	0.2°C	0
Density	A lower seed rate (35 -50kg/Ha) on frost prone paddocks has not yet proven to help to minimise frost damage. In WA, the plants in thinner crops appear more robust and able to better withstand the frost event and the extra tillers formed per plant spread flowering time over a greater window. However we found it allowed more weeds to germinate and compete.	0	0

Table 2: Frost Avoidance Strategies

Strategy	Description
Hay	Growing hay on high frost risk paddocks is a good frost avoidance strategy. However quality hay production is also a risky enterprise.
Sowing Barley	Barley is usually 2°C more tolerant to frost than wheat and has competitive gross margin. Though in SA in our frost chamber we would Schooner Barley was much more frost damaged than Yitpi wheat
Sowing oats	Oats are very frost tolerant (approx. 4°C more tolerant than wheat)
Sowing long season wheat variety	Long season varieties such as Yitpi, Stiletto and Camm frequently avoid frost by flowering later in the growing season, when frost incidence is less. To further reduce frost risk sow these varieties in the middle or end of your wheat program rather than first.
Blending wheat	WA found that blending two wheat varieties (long and short season) is an effective strategy for balancing frost risk with end of season drought. Multiple frost events that damage both varieties are rare, however in SA we found you are better off sowing one paddock of one variety and another paddock of another variety (See results in Chapter 3)
Delay Sowing	Delaying sowing of frost prone paddocks is a valid strategy for reducing the likely hood of a damaging frost. However this decision should be made on a paddock by paddock basis according to the frost risk of the individual paddock, rather than delaying sowing of the whole cropping program. (See Balancing Act Chapter 2)
Pasture	If you have a stock enterprise, on frost prone paddocks develop cropping rotations that are pasture driven. This will reduce cropping frequency, and when cropped it will reduce input costs so that there is less financial exposure in the event of a damaging frost.

Table 3: Frost Tolerance Strategies

Strategy	Description
Target yield	High input crops on frost prone areas are frequently more severely frosted than lower input crops with a lower target yield. WA have demonstrated that reducing N, P, K and seed rates reduces risk, and returns competitive if not better gross margins even if only minor frost events.
Adequate nutrition	Crops deficient or marginal in K and Cu are likely to be more susceptible to frost damage. This may also be the case for Mo. Supplying luxurious levels won't buy any additional tolerance above adequate supply.
Conservative Nitrogen	WA found Crops supplied with late and high applications of nitrogen (organic or inorganic) tended to receive more frost damage than crops with a lower supply. Potential for large opportunity cost with this strategy in the absence of frost so restrict to high risk paddocks.
Variety Selection	Certain varieties may have an ability to super cool, and withstand cold temperatures for longer. In SA we have found Yitpi and Buckley to fit these categories so far.