

Managing frost risk

Northern, Southern and Western Regions

FEBRUARY 2016

Careful planning, zoning and choosing the right crops are the best options to reduce frost risk

Frost damage to cereals is a significant annual production constraint for the Australian grains industry and can result in considerable yield losses. A comprehensive frost management strategy needs to be part of annual farm planning. It should include: pre-season, in-season and post-frost event management tactics.

KEY POINTS

- In some areas the risk of frost has increased due to widening of the frost event window and changes in grower practices.
- The risk, incidence and severity of frost varies between and within years as well as across landscapes, so growers need to assess their individual situation regularly.
- Frosts generally occur when nights are clear and calm and follow cold days. These conditions occur most often during winter and spring.
- The occurrence of frost and subsequent frost damage to grain crops is determined by a combination of factors including: temperature, humidity, wind, topography, soil type, texture and colour, crop species and variety, and how the crop is managed.
- Greatest losses in grain yield and quality are observed when frosts occur between the booting and grain ripening stages of growth.
- Frost damage is not always obvious and crops should be inspected within five to seven days after a suspected frost event.
- Methods to deal with the financial and personal impact of frost also need to be considered in a farm management plan.

Risk management for frost

The variability in the incidence and severity of frost means that growers need to adopt a number of strategies as part of their farm management plan. These include pre-season, in-season, and post-frost strategies.

Pre-season management tactics

There are two types of pre-season management tactics available for growers: 1) at the level of farm management planning and 2) within identified frost zones of a farm.

Farm management planning tactics:

Step 1: Assess personal approach to risk

Consider your personal approach to risk in your business; every individual will have a different approach. As part of this process identify and measure the extent of the risk, evaluate risk management alternatives and tailor the risk advice according to risk attitude. The risk of frost can often drive conservative farming practices, which should be carefully and regularly reviewed in light of the latest research.

Step 2: Assess frost risk of property

Carefully consider the risk of your property incurring frosts due to the location. Use historic seasonal records and forecasts. Spatial variability (topography and soil type) across the landscape should also be considered as cold air will flow into lower regions. Temperature monitoring equipment, such as Tiny Tags, iButtons and weather stations can determine temperature variability across the landscape (see box Temperature tips on page 2).

Step 3: Diversify the business

A range of enterprise options should be considered as part of a farm management plan to spread financial risk in the event of frost damage. This is subject to the location of the business and skillset of the manager but the largest financial losses with frost have occurred where growers have a limited range of enterprises or crop types. Intensive cropping systems especially focused only on canola and spring wheat are often at the mercy of frost more than a diversified business as both crops are highly susceptible to frost damage.

Step 4: Zone property/paddock

Paddocks or areas in paddocks that are prone to frost can be identified through past experience, the use of precision tools such as topographic, electromagnetic and yield maps and temperature monitors to locate susceptible zones. This can help determine the appropriate management practice to use to mitigate the incidence of frost.

Be aware that frost-prone paddocks can be high yielding areas on a farm when frosts do not occur. Once the farm has been zoned as at risk of frost, the frost zone management tactics on page 3 can be considered.



Figure 1: The effects of frost damage on a head of wheat at flowering stage (left) compared to a healthy head of wheat (right).

Temperature tips

Capturing accurate temperature information from within the crop canopy can help to assess frost risk. The best method of determining paddock and crop air temperature is to use accurate loggers placed at the canopy height in crop.

Note that:

- Plant surfaces cool more quickly than the air surrounding them so measuring air temperature is not entirely accurate in determining plant temperature. Temperature increases above the canopy of a crop and, if the canopy is reasonably developed, it also increases below the canopy.
- Measuring temperature at weather station height, such as when a Stevenson Screen is installed at 1.4 m, will not be the same as at the canopy or ground level height. Overnight temperatures at ground level (where heat is being lost) can be up to 5°C lower than those measured in a Stevenson Screen. Differences of 10°C have been recorded. A general rule of thumb is that the canopy temperature is approximately 1.5 to 2.5°C lower than the Stevenson Screen temperature during a frost.
- Temperature recorded at a local Bureau of Meteorology site at the Stevenson Screen height (standard) may or may not correlate well with those experienced at crop height in a particular location. In addition, the strength of the correlation may change depending on the time of the year.
- The more remote the measurement is taken from the actual crop site the less representative it will be.

Freezing below zero

While ice melts at 0°C, the freezing temperature of pure water is actually -40°C. Water and plant tissue supercools at temperatures below 0°C, and will only freeze or form ice crystals around small ice nucleators—the process of ‘ice nucleation’.

These ice nucleators can be particles such as dust and bacteria. Ice formation is often at several degrees below 0°C and will vary depending on the concentration of plant tissue solutes (compounds dissolved in liquid) and the presence of ice nucleators in plant tissues. Generally the colder and longer the duration of sub-zero temperatures, the higher the probability that ice nucleation and freezing will occur.

How does frost affect crops?

Cereal crops are most susceptible to frost damage during and after flowering (Figure 1), and are also susceptible at the earlier stages of booting (from GS39 to GS71 Figure 2). Losses in grain yield and quality from frost primarily occur between stem elongation and late grain filling.

Pulses and canola are particularly susceptible during pod filling and losses may reflect pod wall thickness and the location of pods above or below the canopy. Thick pod walls provide insulation to the developing seeds and can offer some protection against frost. Some pulses have thicker pod walls than other pulses.

Frost damage may be sporadic across a crop within a paddock. Not all plants will show obvious symptoms and symptoms may not be evident until 5–7 days after the frost event has occurred.

Frost can affect crops in several complex ways.

The timing and severity of a frost may affect a crop in three ways: from cold or chilling, to desiccation and then finally freezing (Figure 3). It is a step-wise response, i.e. desiccation will not occur without cold damage first; freezing damage will only occur after first experiencing cold and desiccation damage.

Freezing damage will be random throughout the crop canopy and tissues due to the random nature of the ice nucleation and formation (see box Freezing below zero).

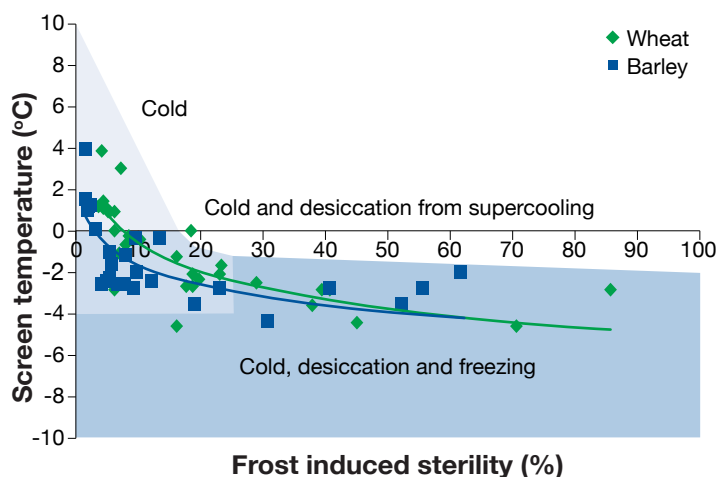


Figure 3: Average frost induced sterility in flowering heads of wheat and barley versus minimum Stevenson Screen temperature from frosts at trials from Western Australia, South Australia and New South Wales frost nurseries 2010–2014.

Susceptibility to frost damage

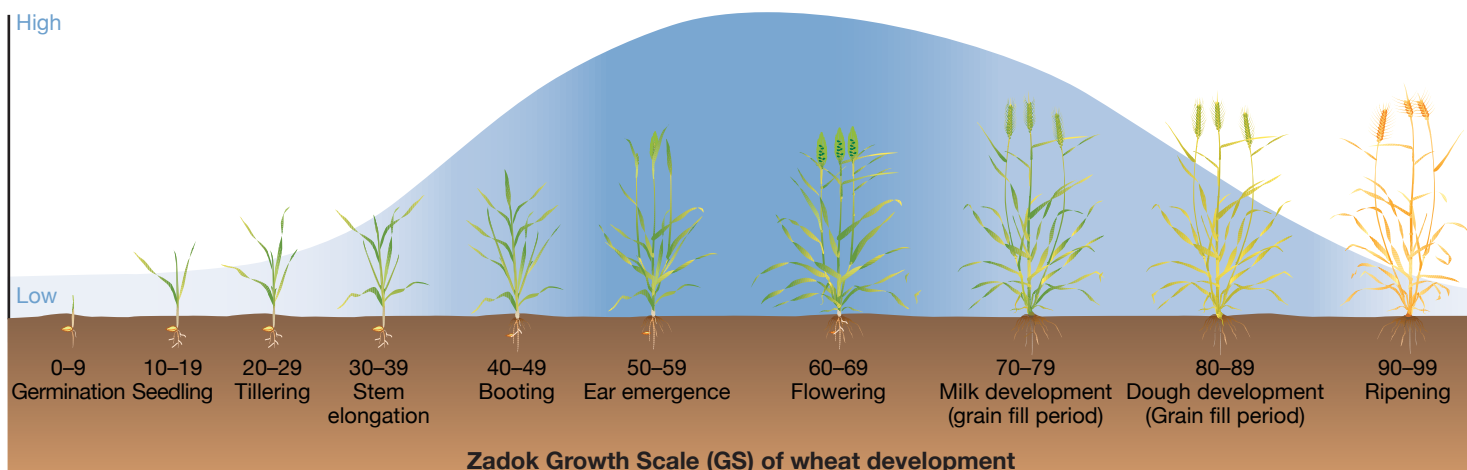


Figure 2: Susceptibility of wheat to frost during the development cycle.

Stages of frost damage

- 1. Cold or chilling damage** occurs when plants are exposed to temperatures less than 10°C down to -2°C (Figure 3). If the changes in temperature are sudden the plant is unable to increase the fluidity of membranes (largely made of fats) at the lower temperature and this compromises cellular and plant energy balances. If this occurs at critical stages in reproductive development this can cause a few or all of the florets to abort during pollen development. The damage is not related to the formation of ice within plant tissue, although it may appear to be.
- 2. Desiccation** from ice formation occurs at temperatures from 0 to -2°C (Figure 3). When plants are exposed to freezing temperatures during a white frost the dew initially freezes on the outside of the plant, but then the ice nucleation can move within the leaf through cracks in the leaf cuticle and stomata. The water inside the leaf then starts to freeze. Initially the water around the cells freezes but it also then draws out the water from inside the cells and dehydrates the cells. The cells themselves may not necessarily freeze or have ice form inside them. This process won't necessarily kill the cells as long as the dehydration and desiccation don't go too far. When the ice thaws these cells can re-hydrate and recover but can still suffer from desiccation.
- 3. Freezing damage** is the final stage of frost damage. It occurs when there is rapid ice nucleation and ice crystals form (Figure 3). The ice crystals physically rupture cell walls and membranes within the cells causing physical damage to the cells. Freezing damage is generally not reversible, but can be limited to specific tissues within the plants, for example stem nodes, individual florets or individual tillers.

Wet canopy equals higher risk of damage

A canopy that is wet from a light shower of rain is more often prone to frost damage than a dry canopy. This is because rainwater contains ice nucleators such as bacteria or dust and therefore the concentration of these nucleators (see box Freezing below zero, page 2) in the crop canopy is often higher. This means a slightly wet canopy from light showers may have a warmer freezing point than a dry canopy.

Frost zone management tactics:

Step 1: Consider enterprise within a zone

The use of identified frost zones should be carefully considered, for example using them for grazing, hay or oat production and avoiding large scale exposure to frost of highly susceptible crops like peas or expensive crops like canola. It may be prudent to sow annual or perennial pastures on areas that frost regularly in order to avoid the high costs of crop production.

Step 2: Review nutrient management

Targeting fertiliser (nitrogen, phosphorus, potassium) on high risk paddocks and seed rates to achieve realistic yield targets should minimise financial exposure, reduce frost damage and increase whole paddock profitability over time. These nutrients could be reallocated to lower risk areas of the farm.

While high nitrogen (N) increases yield potential it will also promote vegetative biomass production and increase the susceptibility of the crop to frost. Using conservative N rates at seeding and avoiding late top-ups results in less crop damage.

It is best if crops are not deficient in potassium or copper, as this may increase susceptibility to frost events. This can be assessed from initial soil tests and with plant tissue testing.

Copper deficiency can be ameliorated with a foliar spray pre-flowering and as late as the booting stage to optimise yield, even in the absence of frost.

Potassium plays a role in maintaining cell water content in plants, which can potentially influence tolerance to frost. It has been shown that plants deficient in potassium are more susceptible to frost. Soils that are deficient in potassium could benefit from increasing potassium levels at the start of the growing season. However it is unlikely that there will be a benefit of extra potassium applied to plants that are not potassium-deficient.

Frost tolerance can not be bought by applying extra potassium or copper to a crop that is not deficient. There is no evidence that applying other micronutrients has any impact to reduce frost damage.

Step 3: Modify soil heat bank

The soil heat bank is important for reducing the risk of frost (Figure 4). Farming practices that manipulate the storage and release of heat from the soil heat bank into the crop canopy at night are important to consider to reduce the impact of a frost event.

Agronomic practices that may assist with storing heat in the soil heat bank include:

- Practices that alleviate non-wetting sands, such as clay delving, mouldboard ploughing or spading, have multiple effects; these include increasing heat storage, nutrient availability and infiltration rate.

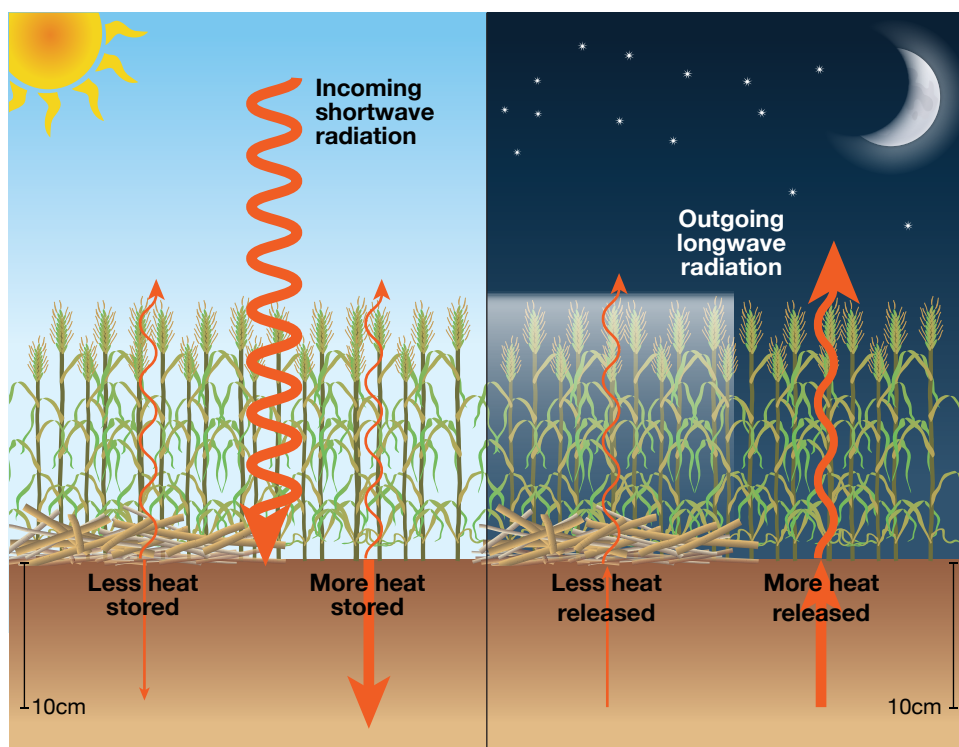


Figure 4: The soil heat bank has an important role. It captures heat during the day and radiates heat into the crop canopy overnight to warm flowering heads and minimise frost damage. A range of farming practices can be utilised to increase the capacity of the soil heat bank

- Rolling sandy soil and loamy clay soil after seeding can reduce frost damage. It also prepares the surface for hay cutting should it be necessary.
- Reducing the amount of stubble: stubble loads above 1.5 t/ha in low production environments (2–3 t/ha) and 3 t/ha in high production environments (3–5 t/ha) generally increase the severity and duration of frost events and have had a detrimental effect on yield under frost.
- Halving the normal seeding rates can reduce frost severity and damage by creating a thinner canopy and more tillers resulting in a spread of flowering time. However, weed competitiveness can be an issue.
- Cross-sowing/seeding. Crops sown twice with half the seed sown in each direction have a more even plant density. Heat is released from the soil heat bank more slowly to warm the crop canopy at head height in early morning when frosts are more severe. This practice, however, increases sowing costs.

Step 4: Select appropriate crops

Crop selection is an important factor to consider for frost-prone paddocks. Crops grown for hay are harvested for biomass and avoid grain loss from frost. Pasture rotations are a lower risk enterprise and oats are the most frost tolerant crop during the reproductive stage. Barley is more tolerant than wheat at flowering, but it is not known if barley and wheat have different frost tolerance during grain fill. Canola is an expensive crop to risk on frost-prone paddocks due to high input costs.

Flower Power (DAFWA) and Yield Prophet are useful tools to match the flowering time of varieties to your own farm conditions.

Step 5: Manipulate flowering times

When wheat is sown in frost risk areas, a good tactic is to ensure the flowering window of the cropping program is spread widely. This can be done by using more than one variety and manipulating sowing date and varieties with different phenology drivers so crops flower over a wide window throughout the season. It should be noted that flowering later than the frost may result in lower yields in seasons with hot, dry finishes due to heat and moisture stress.

Staging sowing dates over a 3–6 week period is recommended. If sowing just one variety, this would provide a wide flowering window. If sowing more than one variety: sow winter wheat first; then a long season spring wheat or a daylength sensitive wheat; then an early maturing wheat last; the whole wheat program is set to flower over a two week period, potentially exposing it to more frost risk but maximising the yield potential in the absence of frost. Even with this strategy in place it is possible to have more than one frost event that causes damage. Flowering over a wide window will probably mean that some crop will be frosted but the aim is to reduce extensive loss.

Sowing at the start of a variety’s preferred window will achieve higher yields at the same cost as sowing late. Sowing time remains a major driver of yield in all crops with the primary objective to achieve a balance between crops flowering after the risk of frost has passed but before the onset of heat stress. The loss of yield from sowing late to avoid frost risk is often outweighed by the gains from sowing on time to reduce heat and moisture stress in spring.

To minimise frost risk there needs to be a mix of sowing dates, crop types and maturity types to be able to incorporate frost avoidance strategies into the cropping system. In years of severe frost, regardless of which strategy is adopted it may be difficult to prevent damage.

Trials have found that blending a short season variety with a long season variety is an effective strategy. However the same effect can be achieved by sowing one paddock with one variety and the other with another variety to spread risks.

What causes frost?

In the Australian grainbelt, frosts occur when nights are clear and calm and follow cold days. In elevated regions frosts are frequently experienced after mild or even warm conditions. These conditions occur most often during winter and spring with the passage of high pressure systems following a cold front. The clear, calm conditions at night encourage heat loss from the ground and the crop itself, decreasing the temperature to below zero at ground level and within the crop canopy.

Often frost will be more damaging when there is little soil moisture, as soil moisture adds to the heat storage capacity of the soil.

Wind and cloud reduce the likelihood of frost by decreasing the loss of heat to the atmosphere. The extent of frost damage is determined by how quickly the temperature drops to zero, the length of time it stays below zero and how far below zero it gets.

Step 6: Fine tune cultivar selection

No wheat or barley varieties are tolerant to frost. Consider using wheat and barley varieties that have lower susceptibility to frost during flowering to manage frost risk of the cropping program while maximising yield potential. There is no point selecting less susceptible varieties for the whole cropping program if there is an opportunity cost of lower yield without frost.

Preliminary ranking information for current wheat and barley varieties for susceptibility to reproductive frost is available from the National Variety Trial website (www.nvtonline.com.au). A new variety should be managed based on how known varieties of similar ranking are currently managed.

Figure 5 shows an example of the ranking of adapted wheat varieties for the Western Region. A grower in the WA Upper Great Southern may be considering how to incorporate Corack[®] and Scout[®] into their cropping program to complement Mace[®] and Yitpi[®]. From a frost risk management point of view, Corack[®] can be treated in the same way as Wyalkatchem[®] or Mace[®]. Given its similar sowing/flowering time response to Mace[®] it can essentially be treated the same in terms of sowing/flowering time and position in the landscape. Scout[®] on the other hand, although similar in frost performance to Yitpi[®], flowers around 5–14 days earlier so may need to be sown slightly later than Yitpi[®] to manage frost risk comparably to Yitpi[®].

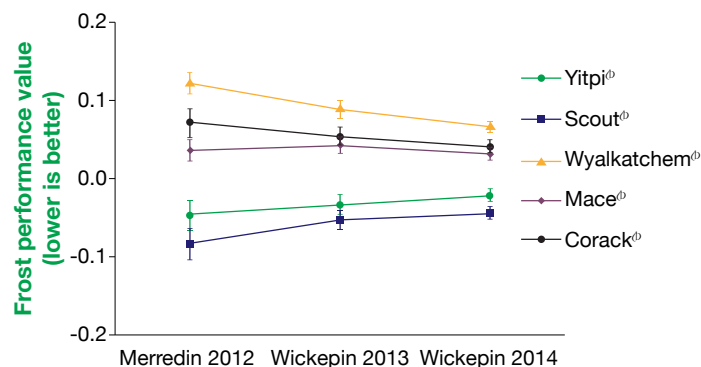


Figure 5: Frost Value of sterility under flowering frost for five wheat varieties tested at Merredin and Wickepin, Western Australia. Each FV for each variety is presented along with prediction standard error bars. Lower FVs are better, indicating lower sterility.

Management tactics within season

The progress of the season should be monitored by regularly assessing weather forecasts and crop development in relation to frost incidence. Decisions may need to be made to implement in-crop management tactics to mitigate frost damage during the season.

Grazing

The key message is to graze early (at the crop four-five leaf stage or even earlier) and graze hard for a short period. Fourteen days grazing delays flowering by about seven days. Grazing after first node (GS31) will significantly delay flowering and reduce crop yield. High stock numbers are often required.

Trials in southern WA and SA have shown grazing wheat crops in winter to delay flowering can reduce grain yield losses from spring frosts by extending the flowering date. Additionally these crops can provide extra fodder for livestock.

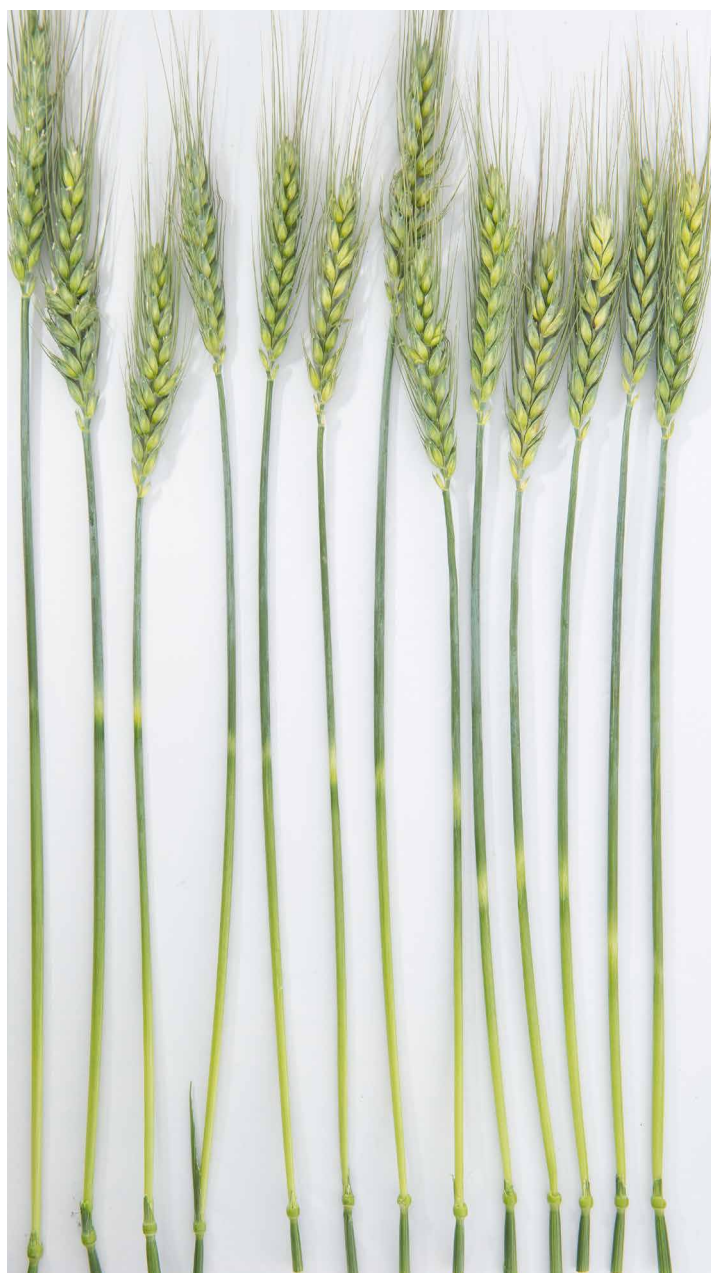


Figure 6: A pale green to white ring on the stems indicates they have been frost-affected. With good soil moisture crops can develop grain even with frost-damaged stems, but it is important to monitor for two weeks after the frost event.

This management tactic can be used as a tool to:

- manipulate a crop's flowering time after seeding
- reduce the amount of crop biomass, which will reduce frost incidence
- compact the soil, which increases the soil heat bank capacity.

Extra nutrients

Conservative input strategies should be adopted for frost-prone areas and minimal or no additional nutrients should be applied during the season. Manage nitrogen to frost risk. Avoid late nitrogen top-ups in zones and paddocks that have been identified during pre-season planning as having higher frost risk.

Copper is the only exception. Tissue test for copper during tillering and apply foliar copper at booting if tissue samples are identified as marginal.

Post-frost event management tactics

Once a frost event (especially at or after flowering) has occurred, the first step is to inspect the affected crop and collect a (random) sample of heads to estimate the yield loss incurred.

In the event of severe frost, monitoring needs to occur for up to two weeks after the event to detect all the damage.

After the level of frost damage is estimated the next step is to consider options for the frost damaged crop.

Option 1: Take through to harvest

If the frost is prior to or around (growth stage) GS31 to GS32, most cereals can produce new tillers to compensate for damaged plants provided spring rainfall is adequate. Tillers already formed but lower in the canopy may become important and new tillers can grow after frost damage, depending on the location and severity of the damage. These compensatory tillers will have delayed maturity, but where soil moisture reserves are high, or it is early in the season, they may be able to contribute to grain yield.

A later frost is more concerning, especially for crops such as wheat and barley, as there is less time for compensatory growth. The required grain yield to recover the costs of harvesting should be determined using gross margins.

Option 2: Cut and bale

This is an option when late frosts occur during flowering and through grain fill. Assess crops for hay quality within a few days of a frost event and be prepared to cut a larger area than originally intended pre-season. Producing hay can also be a good management strategy to reduce stubble, weed seed bank and disease loads for the coming season.

This may allow more rotational options in the following season to recover financially from frost, for example to go back with cereal on cereal in paddocks cut early for hay. Hay can be an expensive exercise. Growers should have a clear path to market or a use for the hay on farm before committing.

Option 3: Grazing, manuring and crop topping

Grazing is an option after a late frost, when there is little or no chance of plants recovering, or when hay is not an option. Spray-topping for weed seed control may also be incorporated, especially if the paddock will be sown to crop the next year. Ploughing in the green crop is to return organic matter and nutrients to the soil, manage crop residues, weeds and improve soil fertility and structure. The economics need to be considered carefully.

Harvesting and marketing frosted grain

The effect of frost on yield and quality of grain depends on the stage of crop development. In general as development progresses through grain filling the grains become drier and they become less frost susceptible.

If affected during:

- flowering: the grain is aborted and yield is reduced but there are rarely any negative impacts on quality of remaining grain.
- watery stage: grain does not develop any solids and frosted grains do not appear in the sample. Unfrosted grains can compensate and are often larger with high test weight.
- milk stage of development: grains may continue to develop, but will be light and shrivelled. They usually have a low hectolitre weight and high screenings, but this can usually be minimised by adjusting header settings (Figure 7).
- late dough stage: can result in wrinkly/scalloped grains. Again, these may have a low hectolitre weight and higher screenings and further cleaning may be required.

In frost damaged crops adjust header settings to maximise the quality of the grain harvested.

Frosted grain is included in the category 'Dry Green, Sappy and Frost Distorted', for which there is a maximum limit of 1% in total. Grain containing over 1% but less than 10% frosted grain is classified as Australian General Purpose (AGP). Any grain exceeding this level will be classified as and suitable for stock feed.

Higher classification of frost-affected grain may be achieved by cleaning grain but the capacity and economics of doing this need to be carefully considered.



Figure 7: Grain frosted at GS71 stage.

Retaining seed from frosted crops

Grain that forms when frost occurs at flowering is often plump and makes good quality seed. However, when frost occurs during grain fill, variable effects can impact on the germination and establishment of these damaged grains.

Even after grading, frosted grain can have 20–50% lower crop establishment than unfrosted grain the following season. As a result growers need to retain more seed than normal, sow into an optimum seed bed and increase seeding rate to compensate for lower crop germination and vigour of frosted grain.

Recovering from frost

- Act early if frost damage has had a serious financial impact.
- Prepare a future business plan and, where necessary, seek advice on tactics from consultants and rural counsellors.
- Communicate and discuss the likely impact of the frost with your bank and prepare a recovery plan with the bank and other financial providers.
- Assess the physical, financial and people situation factually so that decisions are based on the best information.
- Develop alternate strategies for dealing with frosted crops in future programs and how finances can be adjusted.
- Prepare a draft budget and physical plans for next year and provide this information to business partners and financiers.
- Develop a written plan of your proposed actions and review it as information and circumstances change.
- Assess the personal impact. Remain conscious of the fact that frost can cause an emotional rollercoaster and trigger feelings of depression, grief and loss. Maintain contact with family, friends and colleagues and seek professional advice if necessary. Also be aware of the impact on your neighbours and community.
- Remember to assess your own situation and avoid getting caught up in negativity and gossip.
- Frost can be easily forgotten from one year to the next. Don't let early rain distract from having plans in place.



Figure 8: White frost on oat canopy caused by dew forming then freezing on the canopy.

National Frost Initiative

Projects within the GRDC National Frost Initiative have provided some of the information for this Tips and Tactics fact sheet.

The objective of the GRDC's National Frost initiative is to provide the Australian grains industry with targeted research, development and extension solutions to manage the impact of frost and maximise seasonal profit.

The initiative is addressing frost management through a multidisciplinary approach incorporating projects in the following programs:

1. Genetics: developing more frost-tolerant wheat and barley germplasm and ranking current wheat and barley varieties for susceptibility to frost.
2. Management: developing best practise crop canopy, stubble, nutrition and agronomic management strategies to minimise the effects of frost, and searching for innovative products that may minimise the impact of frost.
3. Environment: predicting the occurrence, severity and impact of frost events on crop yields and frost events at the farm scale to enable better risk management.

The changing nature of frost in Australia

The length of the frost season has increased across much of the Australian grainbelt by between 10 and 55 days between 1960 and 2011. In some parts of eastern Australia the number of frost events has increased.

CSIRO analysis of climate data over this period suggests the increasing frost incidence is due to the southerly displacement and intensification of high pressure systems (sub-tropical ridges) and to heightened dry atmospheric conditions associated with more frequent El Niño conditions during this period.

The southern shifting highs bring air masses from further south than in the past. This air is very cold and contributes to frost conditions.

In the eastern Australian grainbelt the window of frost occurrence has broadened, so frosts are occurring both earlier and much later in the season. In the Western Australian grainbelt there are fewer earlier frosts and a shift to frosts later into the season.

The frost window has lengthened by three weeks in the Victorian grainbelt and by two weeks in the NSW grainbelt. The frost window in Western Australia and Queensland has remained the same length, while sites in eastern South Australia are similar to Victoria and sites in western South Australia are more like Western Australia. Northern Victoria seems to be the epicentre of the change in frost occurrence, with some locations experiencing a broadening of the frost season by 53 days.



Figure 9: Sunrise over frost trials in Western Australia with a weather station in-field.

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i Useful tools

Weather apps: see AgExcellence Alliance for a review <http://agex.org.au/>

Plant development apps (eg MyCrop, DAFWA FlowerPower)

Temperature monitors for example see <http://www.hdl.com.au/>

i Useful resources

Cereals - Frost Identification: The Back Pocket Guide, GRDC: <http://grdc.com.au/Resources/Publications/2011/03/Cereals-Frost-Identification-The-Back-Pocket-Guide>

Growth Stages of Cereals - Zadoks Growth Scale: <http://www.nvtonline.com.au/zadoks-growth-scale/>

Flower Power online tool, DAFWA: <https://www.agric.wa.gov.au/frost/flower-power>

Frost and cropping, DAFWA: <https://www.agric.wa.gov.au/frost/frost-and-cropping>

GRDC National Frost Initiative GCTV Frost Playlist on YouTube: www.grdc.com.au/GRDC-Video-NationalFrostInitiativePlaylist

For more information on the interactions between specific crops and frost, see the GRDC Regional GrowNotes at www.grdc.com.au/GrowNotes

Making Effective Business Decisions, GRDC fact sheet: <http://www.grdc.com.au/GRDC-FS-MakingEffectiveBusinessDecisions>

Simple and Effective Business Planning, GRDC fact sheet: www.grdc.com.au/FS-SimpleEffectivePlanning#sthash.EMlBvbu8.dpuf

Farm business management: farmer health – building emotional resilience, GRDC fact sheet: <http://www.grdc.com.au/GRDC-FS-EmotionalResilience>

AWB Wheat Quality Fact Sheet Frosted Grain http://www.awb.com.au/NR/rdonlyres/B2159C4F-09EE-40FF-9A70-856ECF271E11/0/Frosted_Grain_factsheet.pdf

Lifeline 13 11 14 www.lifeline.org.au

MensLine Australia 1300 789 978, www.mensline.org.au

Beyond Blue 1300 224 636, www.beyondblue.org.au

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Acknowledgements

Tim March (UA), Ben Biddulph (DAFWA), Sarah Jackson (DAFWA), Steven Crimp (CSIRO), Peter Hayman (SARDI), Melissa Rebbeck (Climate and Agricultural Support), Garren Knell (ConsultAg), Mick Faulkner (Agrilink Agricultural Consultants (Aust) Pty Ltd), Brian Cullis (Statistics for the Australian Grain Industry, University of Wollongong), Simon Diffey, (Statistics for the Australian Grain Industry, Curtin University).

All photos courtesy of Department of Agriculture and Food Western Australia.

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