

Frost: what's in your management tool box for 2017?

Focus Session Report

A Focus Session entitled 'Frost: what's in your management tool box for 2017' was held on the second day of the Perth Grains Research Updates, 27th - 28th February 2017.

Background

This session was instigated following the 2016 cropping season in Western Australia where severe frosts over a protracted period resulted in significant losses for growers in certain regions. It is estimated conservatively that 2 million tonnes of grain was shaved off WA grain deliveries in 2016, approximately \$600 million in losses to WA growers.

Methods of mitigating losses to frost incurred by growers are being addressed by the multidisciplinary National Frost Initiative formed by the Grains Research and Development Corporation's in 2014. These solutions will include a 'tool box' of tools that growers can deploy before and during the cropping season to mitigate the impact of frost.

The intent of the frost focus session was to do a live and interactive audit of the frost tool box and illustrate the need for growers and consultants to customise tools in their tool box for their own circumstance. This was partly accomplished through provision of the latest information regarding frost mitigation tools by the speakers. A secondary aim was to gather feedback from the participants on additional gaps and needs in the generic toolbox for frost management.

An interactive session was planned chaired by Sue Knights, GRDC NFI Knowledge Manager, which incorporated a suite of speakers from Department of Agriculture and Food WA, ConsultAg, The University of Western Australia and the Grains Research and Development Corporation. Julianne Hill, Co-ordinator of the GRDC's Western Regional Cropping Solutions network oversaw the use of the interactive on line tool 'GroupMap' technology to gather feedback from the focus session participants.

The audience number peaked at around 40, consisting mainly of researchers, and there was lively discussion throughout the session.

The program was as follows:

Peter Roberts, Chair GRDC Western Panel	<i>Introduction to the Focus Session</i>
Ian Foster, DAFWA	Review of last year's frost event
Garren Knell, ConsultAg	The impact of last season's frost and repercussions on a farm business
Ben Biddulph, DAFWA	Current available genetic and management tools for frost.
Nik Callow, UWA	Environmental monitoring tools
Juan Juttner, GRDC	An economic assessment to prioritise research investment in tools to manage frost
<i>Discussion Panel chaired by Julianne Hill, Western RCSN</i>	

Key messages delivered and discussion issues arising from the Focus Session

The session commenced with Peter Roberts, Chair GRDC Western Panel and National Frost Initiative. Peter's key messages were as follows:

- Western panel holds frost as a high priority
- Frost window is getting wider
- A need to manage the impact of frost to maximize profits
- Frost costs even when it doesn't occur
- 2016: cost \$600 million
- The GRDC's National Frost Initiative was designed to assist growers to manage the impact of frost and maximise profit. It combines genetics, management and environment components of research.

Peter was asked the following question through GroupMap "4Farmers is looking to trial an anti frost spray treatment and are looking for partners for field trials"

His response was "Great. Come and discuss further as we have developed protocols to evaluate chemical products ability to change crop sensitivity, severity and duration of frost and subsequent damage." He also had a similar query from HiTechAG Solutions.

Ian Foster followed Peter Roberts and reviewed last season's climatic events that resulted in protracted and severe frost. His key messages were:

- Day and night time temp in September 1 to 2 degrees below average

- Min temp was the lowest in the decile range – very cold year in a historical context as well (coldest September on record, and the month also had the coldest maximum temperatures on record)
- Frost occurrence in August was much greater than previous years
- Number of days below 2 degrees – much greater than average – central eastern wheatbelt/ northern wheatbelt.
- Growing season overall was very cool. The thermal accumulation for 2016 was below average, therefore growing season was slower and prolonged.
- Climate patterns related to a strong Indian ocean dipole (IOD) event were probably the culprit
- Weak La Niña conditions, IOD negative event so warm around Indonesia, cold seas surface temperature anomalies to the south of WA. IOD affects where rainfall occurs

Ian was asked via GroupMap “how early can you predict IOD?” He responded that “models can do it now – 6 months ahead of time but are not very accurate. 2 months out will offer better indications. Winter is when you get a better idea.” He was also asked “how does IOD influence the atmospheric pressure off the coast of South west of WA?” He stated “the influence varies according to the phase (positive, neutral or negative), and how that interacts with the subtropical ridge to the south of Australia. In very broad terms a positive IOD will tend to reduce rainfall, while a negative IOD can help seasonal rainfall.”

Garren Knell followed Ian Foster to talk about the impact of last season’s frost and repercussions on a farm business. His key messages were:

- 2016 was a tale of 2 seasons; highest season on record but significant frost damage seen
- Potential yield was higher than expected.
- Growers were sowing early
- Less diversity ie only Mace and La Trobe
- Less long season varieties planted
- Wheat vs barley, with barley sown early but with short season varieties
- Canola did well, not as bad as other years, lupins badly damaged, and more oats damage with poor quality in Williams, peas badly hit.
- Need to balance the opportunity cost with cost avoidance, hidden costs of frost.
- Growers had three good years before 2016, so there was more of a financial buffer for some.
- There was a loss of research data and trial data
- Lack of investment in productivity
- Lack of capital for succession
- 2016 frosts affected other businesses ie trucking, tyre shops, CBH, GRDCgrdc
- Cannot farm to avoid exceptional and rare climatic events
- Diversity within a business enables growers to ride the frost storm
- Be cautious in placing canola in any frost prone areas of the landscape.

- Equity is a measure of stability:
 - >80% generally safe
 - <65% can lead to serious problems
- There is quite a large opportunity cost or cost of avoidance
- Garren's main tips were:
 - Assess frost risk
 - Diversity flexibility
 - Spread out the seeding program
 - Capitalise on early sowing opportunities

Garren was asked via GroupMap about the market value of barley hay. He responded that the cost of cutting hay can add to your losses if you don't have a market. He was also asked how many farmers consider farm income insurance to help mitigate the risk of severe financial losses due to frost and other perils. He responded that growers are looking closely at insurance as another way to help manage risk. He expects an increase in adoption in 2017.

Ben Biddulph followed Garren Knell and spoke about the currently available genetic and management tools for frost.

His key messages were:

- Don't let frost from 2016 burn you in 2017. 90% of growers ARE doing it right
- A little stubble is OK
- Sow early and sow long, or don't sow wheat at all.
- Frost performance values – minor tool to help you tweak varieties that you have already adopted
- Little bit of stubble is ok, cut them back every few years
- TOS trials time strong effect on frost prone sites
- Variety choice – all get frosted
- Beer Vs Bread, Barley is better than wheat, but it's not frost tolerant, nor are oats.
- N doesn't increase crop sensitivity but bag N does increase financial risk
- Consider K nutrition if sub optimal especially in frost prone areas. Potash gross margins no return on severe frosts but on moderate or low levels get an economic response to K

Ben was asked if crops in lupin stubbles get frosted? He responded that we can't explain what happens with lupins at the moment. As we close the canopy we increase severity and duration of frost. Also questioned about nitrogen application. He responded that usually differences are found in maturities as a result of N treatment rather than N levels. Georgie Troup also stated via GroupMap that increasing nitrogen in oats didn't appear to increase frost sensitivity of oats (data she did not present in her presentation). Ben noted this to follow up. Ben was also asked if the 2016 situation for crop damage could have been worse

if thermal degrees were higher - would flowering have greater synchronicity if it were warmer too? Ben responded that yes synchronicity of flowering time is increased by higher seeding rate, higher nitrogen and warmer temperatures.

Nik Callow's presentation on environmental monitoring tools followed Ben's with the following messages:

- Viewing frosted and unfrosted plants with different monitoring/sensing tools you see differences in spectral reflections, damage response either spectral or thermal
- Spectral - frost causes plant damage and changes the way incoming sunlight is absorbed or reflected. Thermal - frost causes plant damage and changes the way plants regulate temperature ie stem frost
- Different crop varieties exhibit different responses when assessed with sensors
- Thermal imaging for post event detection has many environmental challenges
- Drones show promise but optimal deployment window relative frost event needs to be determined

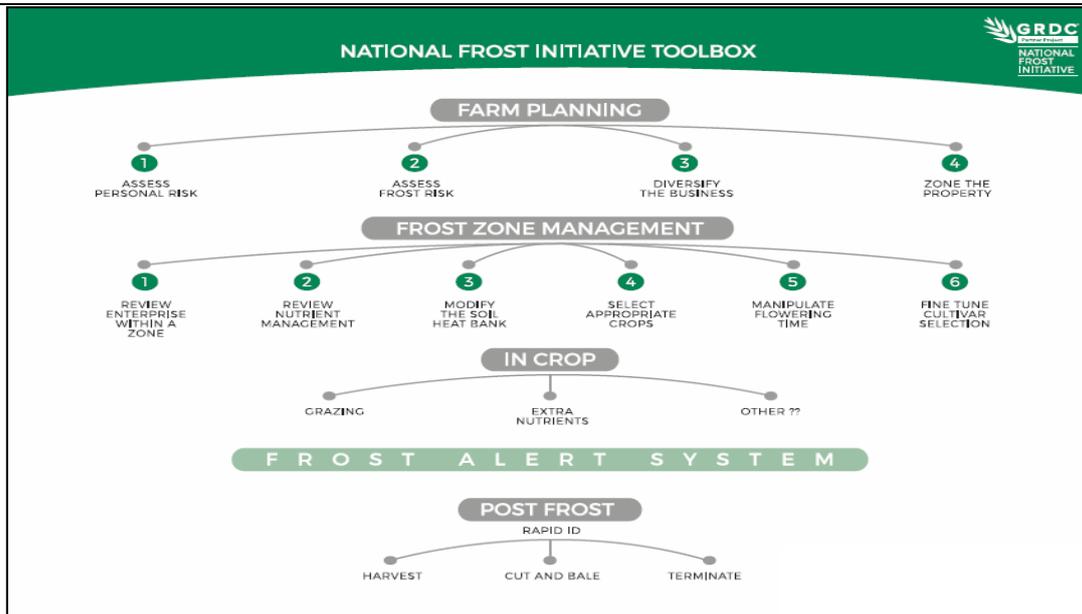
Nik was questioned about the Landgate land surface temperatures. He responded that they are not available anymore. He was also questioned about the optimum timeline available to identify when after a frost event do you monitor? Nik responded that the work has only run one year and that they don't have an answer at this stage.

Juan Juttner followed Nik with his presentation on an economic assessment to prioritise research investment in tools to manage frost. Juan's key messages were

- We would like to deliver a total tolerance package but a 1 or 2°C is more likely and offers a better bang for buck
- Small reduction in reproductive frost sensitive can deliver significant economic value
- Genetic improvements would deliver greatest value in WA
- GRDC have made significant investments into genetic solutions within the National Frost Initiative

There were no questions to Juan after this presentation.

The second phase of the Frost Focus Session was an audit of the frost tool box facilitated by Julianne Hill and utilising the on-line collaborative tool GroupMap. This activity used the 'Shadowboard' concept (below) which provides a decision support framework for developing a customised frost management plan



Participants were encouraged to enter their ideas into the GroupMap tool under the following headings; Farm Planning, Frost Zone Management, In Crop, and Post Frost. These ideas are captured in the table below.

<p>FARM PLANNING: At the Whole Farm business level- Add your ideas below on what you do, what you would like to do, and what you think needs to happen at the WHOLE FARM business level when planning for next season around frost</p>	<p>IN CROP: At the paddock scale after seeding- Add your ideas below on what you do, what you would like to do, and/or what you think needs to happen at the paddock scale after seeding on high frost risk paddocks</p>
<ul style="list-style-type: none"> • Don't necessarily change the whole farm direction to counteract frost given the 2016 frost impacted areas previously not susceptible to frost and didn't touch historically prone areas • Increase varietal diversification • TOS range of dates • Spread seeding dates • Interaction with livestock enterprise- are their advantages from integrated farming systems 	<ul style="list-style-type: none"> • Test to see if smoke can displace or protect against frost • Sheep grazing to manage crop development • Can we manipulate the soil heat bank during crop development • Spray K late prior to frost • Nitrogen management in season-delaying nitrogen application to manage crop canopy density
<p>FROST ZONE MANAGEMENT- On HIGH FROST RISK PADDOCKS- add your ideas below on what you do, what you would like to do, and/or what you think needs to happen to reduce your frost risk on HIGH FROST RISK PADDOCKS</p>	<p>POST FROST: Needs to happen AFTER A Frost- Add your ideas below on what you do, what you would like to do, and/or what you think needs to happen AFTER A FROST at your clients or your place</p>

<ul style="list-style-type: none"> • I have a 4 page summary of my assessment of present knowledge • I know of six possible methods, some dating back to 1983 • Mixed enterprises, use frost prone areas for stock, allow frost to do pasture manipulation • Eliminate frost and Ice Nucleating Bacteria (INA) • Sell it to the neighbour • Plan crop type timing nutrition, monitor levels/ Bricks level tissue test • Go for the jugular- eliminate frost and INA bacteria • Lower seed rate to increase spread of flowering • Grain and graze, use crop grazing to delay flowering • Oats for grain • Grow hay- have a relationship with hay exported and contract in writing early 	<ul style="list-style-type: none"> • If big \$ impact likely talk to advisers and bank about strategy forward • Go on holidays • Simple assessments to work out what level of damage. Ensure you know what frost damage is. • Need to know the functionality of the different varieties after a mild frost event what still passes into acceptable grades but decreased yield • Keep talking • Easier assessment of frost damage to crop
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Recommendations

As can be seen from the responses in the table there were several common themes running across the 4 categories of tools. Ideas were presented about business diversification, particularly the use of stock for dual purposes; both for financial benefit and to manipulate crop development and oats for both grain and hay. Varietal diversification, time of sowing and input adjustments (N and K) were mentioned. The need for easier methods of damage assessment was captured with the GroupMap tool. The importance of emotional and financial support post a frost event was also noted.

The following recommendations arose from the Focus Session and the appropriate agency is noted in italics to progress each recommendation.

1. Reconsider the timing, placement and nature of focus sessions within the Update Program. *GiWA and GRDC to consider*
2. Carefully consider the way in which the Focus Sessions are structured; avoid too many presentations and ensure that discussion time and use of expert panels are maximized. *GiWA and GRDC to consider*
3. Careful and considered messaging about the management of frost by growers needs to be conducted for 2017 in Western Australia given the devastating impact of the 2016 season. *GRDC to pursue within the National Frost Initiative (NFI) and collaborate with other agencies.*
4. There is a need to determine the validity of some long standing frost issues; for example the involvement of ice nucleating bacteria (INB) in frost events and smoke to mitigate the effects of frost. The role of the GRDC's National Frost Initiative as a

- 'myth buster' should be considered. *GRDC to pursue within the National Frost Initiative.*
5. Consider the evaluation of novel frost mitigating sprays on crops. *GRDC to consider through the NFI*
 6. Consider opportunities to manipulate the soil heat bank capacity in crop. *GRDC to consider through the NFI*
 7. Consider communication opportunities on the following issues for 2017:
 - a. Enterprise diversification and in particular livestock integration
 - b. Further communication of the nuances of sowing date/ variety choice
 - c. Easy options for frost damage assessment as the research progresses in this area *GRDC to consider all of these through the NFI*
 8. Further communication of the genetic economic analysis should be considered to manage expectations of industry as to what will be delivered from the National Frost Initiative in terms of a genetic solution. *GRDC to pursue within the National Frost Initiative.*
 9. The evaluation of quality aspects of frosted grain should be investigated in terms of financial return. *AEGIC to consider.*
 10. Information and tools for emotional support post a frost event should be considered as part of the toolbox. *GRDC to consider within the NFI.*

Conclusion

The Focus Sessions were run at the end of 2 very full days of the Western GRDC Updates and there were five focus sessions competing for participants. Due to these factors the Frost Focus Session had a small number of participants and it was also a challenge to maintain engagement of the tiring participants over a 2.5 hour session. It is recommended that the organisers review the nature and timing of these interactive activities in the Update program.

It was also challenging combining the GroupMap technology into the session. It took time to get all the participants on-line and then they tended to become a bit distracted by the technology. As they were directed to interact through the technology this took time away from the opportunity to engage in discussion and debate with the panel of experts in attendance at the session. Although the technology facilitated the capture of the participants' ideas it did rather compromise the social dynamic of discussion.

Further opportunities were identified during the Focus Session for frost mitigation methods within the 'shadowboard' categories of the frost management toolbox. climate and environment classification, germplasm introduction, NVT evaluation and crop variety development. Again recommendations were made and appropriate agencies identified to follow up on these issues.



Relevant links

GRDC Managing Frost risk Tips and Tactics www.grdc.com.au/ManagingFrostRisk.

Frost Values- ranking the susceptibility to frost of current wheat and barley varieties www.nvtonline.com.au/frost.

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