Hail damage can occur at any stage throughout the fruit growing season. Usually, when hail occurs early in the season it causes deep depressions and deforms the fruit (Figure 1), while later-season hail damage often results in bruising the fruit (Figure 2). Hailstone size and intensity will also influence how much damage the fruit receives (Figure 3).

Figure 1. Hail damage causes large wounds in fruit.

Figure 2. Hail damage can cause puncture wounds.

Figure 3. Hailstones range in sizes, causing differing degrees of damage to fruit.

Assessing the damage
Assessing the damage to your orchard after a hailstorm helps you make informed economic decisions for the rest of the growing season. Block-by-block assessments should be carried out to determine if it is economical to proceed with normal crop management for the current season or not.

Assessing the damage can be as simple as recording how many fruit are damaged from a sample of 100, providing you with an easy estimation of the percentage of fruit affected. If the damage intensity varies significantly across a block, it would be best practice to conduct multiple samples of 100 fruit each to improve accuracy. Without assessment data, it will be difficult to make confident and informed decisions on how to proceed with management, storage and processing.
**Disease risk**

Hail damage predisposes trees and fruit to infection from pest and disease, therefore careful management after hail is crucial (Fruit Growers Victoria 2018). Severely damaged stems and branches should be pruned (if practical) and fallen fruit should be cleared from the orchard to reduce infection sources.

Fruit rots and associated decay are more prevalent after a hailstorm, especially where high relative humidity combines with fruit and tree damage to encourage disease development. Applying fungicide immediately after hail decreases the risk of disease establishing in small puncture wounds in the fruit. Large wounds can occur if branches are snapped; these can be covered with a water-based paint to avoid desiccation and decrease infection risk. Experience shows that hail-damaged fruit is more likely to breakdown in storage due to fungal rot infections.

**Reducing the effect of hail damage**

Tree health inputs such as fertiliser and water should be maintained, even in severely damaged blocks. Allowing the trees to suffer additional stress from lack of nutrition or water will affect next year’s buds and crop (Fruit Growers Victoria 2018).

Trees that were damaged early in the season might benefit from a layer of mulch around their bases. Mulch can decrease soil temperature fluctuations by acting as a buffer, which is particularly useful in the summer months.

Mulch also helps retain water in the rootzone, decreasing water stress in the tree.

Thinning can be used to selectively remove hail-damaged fruit and to improve the yield and quality of remaining fruit. Deciding to undertake additional thinning should be guided by your damage assessments as well as considering how additional thinning could affect final fruit size. Removing damaged fruit early, if practical, can improve the final yield.

If growers choose to leave the fruit on the trees and manage it through to harvest, it is important that this fruit is not left to become over-mature because this will make it more susceptible to breakdown in storage.

**After harvest**

Applying a postharvest fungicide dip to the fruit before it goes into storage can reduce the risk of fungal infections occurring. Postharvest fungicides with label registration to reduce postharvest rots are listed in Table 1. Refer to the label for mixing compatibility with DPA and calcium chloride. Do not use treatments where fruit is being exported unless they are permitted by the importing country.

Past experiences across NSW growing regions show that long-term storage of hail-damaged fruit is not a reliable strategy. Significant losses due to fruit breakdown are highly likely. Fruit with the most severe damage should be processed first and stored for the shortest period.

Table 1. Postharvest fungicides registered for use on NSW grown Apples and Pears.

<table>
<thead>
<tr>
<th>Fungicide (MOA)* Group</th>
<th>Active constituent</th>
<th>Example trade name(s)</th>
<th>Diseases shown on label</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thiabendazole</td>
<td>Storite®, Tecto Flowable®</td>
<td>Botrytis cinerea (Grey mould) Gloeosporium album (Fruit rot) Penicillium expansum (Blue mould)</td>
</tr>
<tr>
<td>3</td>
<td>Imazalil</td>
<td>Fungazil®, Imazacure®, Magnate®</td>
<td>Penicillium expansum (Blue mould)</td>
</tr>
<tr>
<td>12</td>
<td>Fludioxonil</td>
<td>Fludy®, Scholar®, Starling®</td>
<td>Penicillium expansum, P. solitum (Blue mould)</td>
</tr>
</tbody>
</table>

*MOA = Mode of Action.
To help apples maintain their fresh-picked qualities such as crunch, taste and juice, the active constituent 1-methylcyclopropene (1-MCP) can be used. It works with the natural ripening process to temporarily stop the fruit from producing ethylene and from responding to outside sources of ethylene. The negative effects associated with ripening are delayed and quality can be maintained. Consult your registered applicator to discuss the suitability of using 1-MCP on hail-damaged fruit.

Some growers might choose not to treat their hail-damaged fruit due to extra costs. In these cases, it is important to remember that ethylene levels will increase in the storage room after harvest. This will accelerate breakdown and reduce the time the fruit can be stored.

To control bacterial growth in process water, sanitisers such as bromochlorodimethylhydantoin (Nylate®), chlorine-based products or peroxyacetic acid can be used. Only products registered for use in fruit processing can be used. Check the labels for registration details and directions for use.


**Marketing**

Hail damage will reduce the market value of the fruit, and after hailstorms, the local juice market is often saturated with produce, resulting in lower prices. Therefore, different marketing options might provide more beneficial ways to sell fruit.

Local markets can present opportunities for growers to reach out to the local community. This can also ‘close the gap’ between consumer perception and what really occurs in an orchard. Creating awareness around these problems in orchards can gain significant consumer understanding and support.

‘Pick your own’ can be another option for smaller growers. It involves allowing consumers to enter your farm to pick the fruit straight from the orchard. Although this can be a great way to get community involvement in your orchard, visitors can unintentionally bring pests, diseases and weed seeds with them, posing a biosecurity risk to your orchard. There are simple ways to reduce this risk when planning to invite the public into your orchard (Farm Biosecurity 2013), including:

• providing a designated parking area located away from production areas and packing houses
• having an area for visitors to wash their hands and providing footbaths for them to clean their shoes before entering the blocks
• if practical, have dedicated areas where pick your own can occur, instead of opening the whole orchard to the public
• check the areas visited by customers frequently for signs of diseases, pests and weeds.

A good marketing example occurred in 2018 when South Australian growers marketed their hail-damaged fruit as ‘Hailstorm Heroes’ (Horticulture Innovation Australia Limited 2018). This was a great way to encourage consumers to see that the fruit was only superficially damaged and therefore still suitable for purchase (Figure 4).

Growers also have the opportunity to use hail-damaged fruit in cider production. Cider is made by pressing apples to produce juice, then fermenting that juice to make alcoholic cider. This process means that the size, shape and external appearance of the apples has no relevance in determining their quality and saleability (Pickering 2008). However, if there are significant quantities of bruised and damaged fruit that is stored for a long period before being processed into cider, then the overall juice quality could be reduced.

Juice companies should also be careful when accepting heavily decayed fruit. This is because the increased decay risk (with blue mould) will also increase the risk of patulin (a mycotoxin produced by some moulds) contamination of juice fruit after storage.
Support for affected producers

For more information on protecting your orchard, please contact DPI Development Officers Jessica Fearnley on 0437 284 010 or Kevin Dodds on 0427 918 315.

NSW Rural Assistance Authority

Low interest loans will assist in replacing and repairing on-farm infrastructure, such as tree netting, fencing and equipment. Details on available assistance is available from the NSW Rural Assistance Authority website at www.raa.nsw.gov.au, or by calling 1800 678 593.

NSW DPI Rural Resilience Program

The Rural Resilience Team work proactively in partnership with farming communities and service providers across NSW to strengthen networks, exchange information and deliver relevant initiatives that build personal and business resilience skills and knowledge, enabling people to move forward in a positive direction. Contact details for your nearest Rural Resilience Officer can be found at www.dpi.nsw.gov.au/about-us/rural-support/RRP.

Rural Adversity Mental Health Program (RAMHP)

RAMHP Coordinators are based across NSW and are able to provide specialist knowledge and support for people experiencing mental health concerns living in the rural communities they cover. RAMHP Coordinators can be contacted regarding non-crisis situations during business hours. More information can be found by visiting www.ramhp.com.au/.

Prevention

Hailstorms are unpredictable and the damage they cause can vary greatly. Prevention is better than cure when trying to combat hail damage in your orchard. Hail netting can provide protection against hail damage (Figure 5). Both structured and drape netting can provide a degree of protection from severe damage. An increased percentage of netted area due to the Office of Environment and Heritage Flying Fox Netting Subsidy has helped protect many growers from 100% loss this season. To spread the cost of netting, growers should plan to net small proportions of their blocks every year, beginning with the most valuable blocks.

Diversifying your orchard location can also help to alleviate some damage as not all blocks are located together. Hailstorms will usually come in cells which have bands of hail. In some cases, orchards in different locations will not receive any hail, reducing the impact to the grower.
References


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