

Noise from frost fans

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1. Introduction

Horticulture is a major primary industry in Victoria, providing a livelihood to many people. A significant threat to the industry is the impact of frost on crop yields. A severe frost can reduce yields by more than 50 per cent (sometimes up to 100 per cent), creating management problems for the current as well as future seasons.

Frost fans are commonly used as a means of protection against frost, but they may cause conflict between residents and growers because of the noise they create. This information bulletin provides some guidance on planning and using frost fans to avoid such conflicts.

As frost fans are primarily used at night, the minimisation of sleep disturbance effects is a key issue addressed by this information bulletin. In areas with low levels of background noise, the intrusiveness of noise from frost fans can degrade the amenity at surrounding houses.

2. Alternatives to frost fans

Where noise impact due to frost fans is likely to be an issue, alternative protection measures should be considered. Each alternative has its advantages and disadvantages, which should be considered when deciding on the most appropriate frost protection strategy. Not all options are viable in all situations and more than one option may be needed to provide the best strategy to reduce frost damage.

2.1. Options for new orchards or vineyards

In considering a new horticultural venture that has a frost-sensitive stage, select an area which is not unduly frost-prone. This is not easy to judge, as severe frosts may only be a one-in-five or 20-year event. Climate data can be obtained from the Bureau of Meteorology to assist with planning (www.bom.gov.au).

If the area is frost-prone, consider planting a different cultivar or crop that flowers later in the season or is more frost-resistant.

The layout of the orchard or vineyard is also an important consideration and should take into account the contours of the land. This may entail planting the more frost-susceptible trees or vines on higher ground where cold air is less likely to accumulate. Dense windbreaks or trees planted across the slope can dam cold air and raise the level of damage higher up into the trees or vines. Creating gaps or planting dense windbreaks down the slope will enhance cold air 'drainage' and reduce the impact of frost on crops.

2.2. Options for existing crops

In areas where there is an existing orchard or vineyard, other measures may need to be considered. These could include:

- applying a copper-based spray that reduces ice-nucleating bacteria on trees
- irrigation

or

- the use of frost-misting microsprays that warm the air surrounding the crop by the release of latent heat as the water freezes.

2.3. Potential off-site impacts

Whether the system for frost prevention is for a new crop or an existing crop, the grower must be conscious of the off-site impacts of any frost-mitigating systems put in place. Impacts may include spray drift from a copper-based spray, excess water from microsprays that could lead to waterlogging during a particularly prolonged frost period, or noise - which is the issue with frost fans.

Frost sensitive periods for crops

The most frost-sensitive period for crops varies according to the type of the crop. For deciduous fruit trees such as apricots, peaches, plums, nectarines and almonds, the main damage from frost occurs at flowering and during very early fruit development. This may be at a different time for each type of deciduous fruit tree and even for different varieties of the same fruit.

Grapevines are affected from bud green tip stage onwards, with severe damage occurring with later frosts during the growing season.

Deciduous fruit trees and vines are not affected by frosts whilst they are fully dormant.

In non-deciduous species, such as lemons, grapefruit and oranges, the frost-sensitive period is during late autumn, winter and early spring. Very severe frost not only damages the fruit but can also damage foliage, twigs and even the outer branches - especially on lemons.

3. What are frost fans and why are they used?

Frost fans are large fans used to circulate air over a wide area where crops such as citrus, stone fruit or vines are grown.

The fans are used on occasions when there is a risk of frost damage to the plants and fruit.

Frost fans work by drawing warmer air from above the orchard (above the inversion layer) and blowing it through the orchard during the frost danger period.

Frost fans may be in fixed positions within the property or they may be portable.

4. What is the noise issue with frost fans?

Noise from frost fans comes from the turning of the fan and the motor that drives the fan. Often the noise can be heard many hundreds of metres from a frost fan.

As the risk of frost occurs at night and in the early morning when the air is still, frost fans are in operation when people are generally sleeping or carrying out 'quiet' activities. This coincides with the period when noise from other sources (background noise) is at a minimum. In quiet areas, the noise from frost fans

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can distract the attention of residents from activities such as reading, relaxing or watching television. It can cause sleep disturbance or cause people to change their sleeping habits to avoid sleep disturbance.

To lessen the amount of disturbance caused by frost fans, it is important that their use and associated noise is minimised while still allowing the protection of crops. To achieve this required outcome, this information bulletin provides recommended indoor and outdoor noise levels that should be met at the location likely to be impacted by the noise (see section 6.2). Outdoor levels must be met and indoor levels must also be assured where there is a high risk of them being exceeded.

5. When should I use frost fans?

In order to minimise noise impact, frost fans should only be used when there is a need for protection against frost damage. The timing and duration of the use of the fans can vary, depending on the type of plants and local climatic conditions.

It is inappropriate for frost fans to be used at times when the crop is not threatened by frost, such as when air temperatures are high enough to prevent frost, and when plants are at a more frost-tolerant stage of their growth cycle. Most plant varieties will be affected by frost when the temperature around the plants gets to 0°C or below. However, it depends on the stage in the growth cycle as to whether this temperature will have a significant effect on the yield or quality of produce.

Frost Fans should only be used when the temperature around the plants is below 0 to 1°C and the trees/crop are at a critical growth stage.

The timing of the critical stages and therefore when a frost fan is likely to be used should be discussed with the local community likely to be impacted by noise from the frost fan. This will enable the community to understand the likely times and frequencies when frost fans will be used. This is discussed further in section 7.

6. Recommended noise levels

6.1 Legislative framework

There are no legislated noise standards for frost fans in Victoria. However, legislation such as the *Environment Protection Act 1970*, *Public Health and Wellbeing Act 2008* and *Local Government Act 1989* (under which local laws can be made) need to be considered.

Farming activities, like other industrial operations, must not cause a 'nuisance' (*Public Health and Wellbeing Act 2008*) or 'pollution (including unreasonable noise)' under the *Environment Protection Act 1970*.

Where complaints are received, either the local council or EPA can investigate and can take action to remedy the problem if it is considered that the noise is unreasonable and excessive. This may be through a nuisance action under the *Public Health and Wellbeing Act* or a pollution abatement notice under the *Environment Protection Act*. Either of these could direct the frost fan operator to decrease the noise from the fans and/or restrict when the fans can be used.

6.2 Applying the recommended noise levels

Many noise standards or guidelines recognise that areas with different population densities, characters and natures warrant different noise criteria to reflect the normal expectations of people living in those areas.

The rural area of Victoria is large and diverse and allows both farming and dwellings, generally without requiring a planning permit. The people living in these dwellings may have different amenity expectations based on how they derive their livelihood.

Given the differing sensitivities of occupants of rural areas, different levels of acceptable noise exposure are appropriate to the corresponding amenity expectations. The nature of the uses allowed or expected in the different planning zones will also shape amenity expectations and attitudes to noise.

Residents of more sensitive land-use zones such as for residential or rural living can reasonably expect a high level of amenity. Therefore, careful management of impacts from activities in or near these zones is needed to ensure the protection of the amenity of residents in these zones.

In recognition of land-use zones such as the 'Farming Zone', where agricultural activities are encouraged, a greater level of noise associated with agricultural activities is allowed compared to a 'Rural Living Zone' or, to a lesser degree, the 'Rural Activity Zone'.

The recommended noise levels are also influenced by the frequency of operation of the frost fan. If frost fans are expected to be used more than 12 times during the frost-sensitive period, more restrictive noise levels must be met.

The recommended noise levels to be considered when assessing the impact of frost fan noise are detailed in Table 1. They relate to noise received at dwellings (houses and other accommodation uses).

If the affected dwelling is located in a 'Farming Zone' and experiences less than 12 frosts a year, due to the noise reduction required, meeting the outdoor level may not ensure that the indoor level is also met.

In these circumstances where the outdoor noise level is predicted to exceed 45 dB(A), a suitably qualified acoustic consultant¹ should be engaged by the proponent to estimate indoor noise levels. If the indoor levels are likely to be exceeded, the proponent may ask the acoustic consultant to recommend appropriate building treatment to enable acceptable use of the proposed frost fans in line with the indoor criteria, subject to consultation with the dwelling owner.

¹ For example, a member of the Association of Australian Acoustic Consultants, www.aaac.org.au, or other suitably qualified and experienced acoustic professional.

Table 1: Recommended noise levels for rural planning zones

Planning zone categories	Outdoor noise level (dB9A) ⁵		Indoor noise level (dB9A) ⁵
	< 12 likely frost events ⁶	≥ 12 likely frost events ⁶	
Residential/Rural Living ^{1, 2}	40		25
Rural Activity ³	45	40	30
Farming ⁴	50	45	30

1. Residential/Rural Living is land zoned in the planning scheme as 'Residential 1', 'Residential 2', 'Residential 3', 'Low Density Residential', 'Mixed Use', 'Township' or 'Rural Living'. The 'Rural Conservation', 'Green Wedge' or 'Green Wedge A' zones are also included in this category. Zones in this category are considered noise-sensitive areas.
2. The recommended noise levels for 'Rural Activity Zone' may be applied to specified areas of 'Green Wedge Zone' where:
 - current and future anticipated land use is acknowledged by the local council to be an intensive farming area in nature; and
 - all allotments are fully utilised and it is not planned to develop land for residential purposes.
3. Rural Activity Zone recognises those areas where farming and other rural lifestyle activities can coexist, as described in the Department of Sustainability and Environment's *New Zones for Rural Victoria*, published in June 2004.
4. Farming zone recognises those areas where farming is the predominant use. The aim of this zone is to cater for the full range of farming activities, as described in *New Zones for Rural Victoria*.
5. Indoor measurements are made with the window closed in a habitable room: any room other than a kitchen, storage area, bathroom, laundry, toilet or pantry. The predicted or measured noise levels are $L_{Aeq, 15min}$ with all frost fans (proposed or actual) operating.

$L_{Aeq, 15min}$ is an A-weighted average sound energy that is measured over a specified period, which in this case is 15 minutes. The 'A' refers to a frequency filter that is applied to the sound being measured, to more closely represent how humans perceive sound. Outdoor measurements are made at least 3.5 m from the external wall of the building.
6. 'Likely frost events' - the mean number of days per year with a minimum daily temperature less than 0 °C for the months of May to December (inclusive). This is recorded at the most relevant meteorological monitoring station and averaged over the number of years of recorded meteorological information (available from www.bom.gov.au).

7. I propose to install a frost fan to protect my crop. What do I need to consider?

Horticulturalists should consider all options for frost protection and assess whether a frost fan will provide the best method of mitigating frost, balanced against the protection of the amenity of the local community.

The following steps are recommended when considering the use of frost fans.

1. Check the following with your local council before the installation of the frost fan(s):
 - the zoning (or likely new zoning) of the affected area to determine the applicable noise levels
 - whether a planning permit is required or other planning scheme requirements apply
 - if there are any local laws or other council requirements that apply.
2. Consider the likely location of the frost fan in relation to nearby dwellings, while still siting it to remain effective in its operation.
3. Ensure that the supplier of the fan has adequate information on noise levels to enable an assessment of the likely risk the fan will pose to local sensitive noise receptors. Noise levels should be estimated at dwellings within 1000m of the nearest fan. Dwellings at further distances may need to be considered if many fans are proposed or the fans are of a noisier design, or residential/rural living areas may be impacted (given that the outdoor criterion of 40 dB(A) for that category may be exceeded at larger distances).
4. Discuss the proposal with the Environmental Health Officer of the municipality. He or she may have an opinion as to whether the proposed use of frost fans is likely to pose a potential nuisance given the particular nature of the area and fan location.
5. Attempt to discuss the proposal with the owners or occupiers of dwellings and other accommodation uses within 1000 metres of the closest proposed fan. Provide them with information about the location of the fans, the likely noise levels, the operational settings such as when and how often you estimate the fans will be used (as discussed earlier in this bulletin) and other information that may be relevant in your particular circumstances.
6. If the outdoor recommended noise level is predicted to be exceeded (or is only just met and there are concerns that the indoor level will be significantly exceeded), seek the advice of an acoustic expert on what acoustic work (such as improved sealing or double glazing of windows) could be undertaken to the affected resident's property to achieve the indoor recommended noise level.
7. To assist any regulatory body such as the local council in determining an application for a new frost fan, it may be helpful to indicate the opinions of potentially affected persons on the frost fans. This, however, will not remove the right of any person who provides consent to seek noise mitigation measures if the operation of the frost fan results in unreasonable noise in the future.
8. If the objections cannot be resolved and the noise criteria cannot be achieved then EPA suggests that other means of frost control be employed on the property.

8. Further information

For further information contact your local council office, EPA Customer Service on 1300 EPA VIC (1300 372 842) or visit EPA's website www.epa.vic.gov.au.