

Winter protection of soilless substrate grown strawberries

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This factsheet provides growers with information about the risk of winter cold injury occurring in strawberries and offers guidelines on the best forms of protection.

Introduction

The unusually hard winter of 2010/11 threatened strawberry crops on many farms. The worst damage occurred in soilless substrate grown crops, particularly those on tabletops. A number of protective measures can be taken to improve winter protection.

In Britain, winter weather is predominantly mild and wet so the routine additional protection practiced

in more continental climates is rarely needed. However, with a significant number of growers now using soilless substrates in Britain coupled with occasional colder winters, many strawberry businesses are at greater risk of cold injury (Figure 1).

It can be difficult to know just what level of cold protection to provide particularly as the severity of the

winter conditions ahead is unknown. This factsheet outlines measures available for protecting soilless substrate grown crops and how to tailor them to your farm's resources. The physics of heat transfer in crops is well understood but lies outside the scope of this factsheet, which outlines practical steps to consider.



1 In cold, harsh winters, strawberry crops are at risk of cold injury, particularly those grown in soilless substrates in bags and containers

What contributes to cold injury?

When considering whether a crop is at risk, be aware of the following factors that contribute to cold injury:

- Growing conditions before freezing
 - Crown size, canopy development, and a lesser extent variety
 - Freezing duration and temperature
 - Exposure to wind
 - Desiccation of the crown
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Factors that increase the risk of damage

A number of factors appear to increase the risk of freezing damage in substrate grown strawberries. Many of these factors were observed following the winter of 2010/11:

- **Soft growth** in late autumn preceding a severe cold spell. A reduction in nitrogen use during October will prevent an abundance of lush growth.
- **Older crowns** (i.e. over two seasons old) were more severely damaged than well grown one year old crowns in 2010/11. Older crowns are more elongated and exposed to wind chill.
- **Shallow planted crowns** with much of the crown proud of the compost – commonly found in tray plants.
- **Crops on table tops** - bags and troughs in the air fared worse than those on or near the ground in 2010/11. They are more exposed to wind run that

cools the crowns more quickly. Ground based crops can also benefit from a prolonged snow covering, though the presence of snow cannot be guaranteed every time there is a cold spell.

- Location in known **frost pockets** and **windy areas**. In 2010/11, it was common to see highly variable damage across a single field with uneven topography.
- **Waterlogging** - in a few cases in 2010/11, there was poor drainage in ground based bags. Poorly drained composts contain more water. Moisture protects against cold damage up to a point as it releases heat as the ground begins to freeze. However, once frozen it is highly damaging as large quantities of ice prolong cold exposure to roots, which may already be weakened by root diseases that thrive in cold, wet conditions.
- **Crown desiccation** occurs

in windy conditions, drawing water from the leaf canopy, but this cannot be replaced by the roots as they are frozen.

- **Soil with long grass** will hold less heat for release at night than if the grass is mown short.
- **Variety** - Sonata generally seemed to survive better than Elsanta in 2010/11, but there are many other variables (listed above), which may confuse this comparison. The HDC mainseason strawberry variety trial showed no winter damage across nineteen varieties in 2011. It was planted in 2010 as a 60-day soil crop, based in Staffordshire and was buried in snow.

No trials data exists which allow comparisons to be made between the significance of these factors. However, it is certain that protective measures will help to reduce the speed of chilling, thus increasing the lowest crop temperature and the duration of such a temperature.

Is damage critical?

Growers are often aware that some level of damage has occurred when assessing strawberry crown tissue after a cold spell. It can be difficult to quantify the damage and know if it is critical.

Crowns should be cut in a longitudinal cross section to inspect for tissue damage. Within several days of thawing, the upper portion of crown tissue appears to be light brown in colour and watery and may take over a week to show the beginnings of browning.

In early spring 2011, many strawberry businesses were fearful of losing significant yields due to winter damage. It was interesting to find that most crops were retained for fruiting despite evidence of winter damage and in most cases, they provided acceptable yields.

Plants can recover from mild winter damage, especially if conditions in spring are conducive to slow growth and development. However, plants rarely recover when the crown tissue is dark brown near the top of the crown.

Figures 2-4 illustrate crowns with varying levels of damage following the winter of 2010/11 and provide information on how they performed in the 2011 season.

This ability to cope with cold demonstrates that even a slight improvement in winter protection can be a great help.

Damaged Crowns Cut Open In Spring



2 An elongated 2-3 year old crown damaged beyond hope



3 A borderline damaged crop with acceptable yield



4 This crop still delivered an exceptional yield, though will be shorter lived

Understanding the effect of weather and the type of damage

The words 'frost' and 'freeze' are frequently used, but they describe two different types of cold event.

Freezing

Windborne freezing occurs when a large amount of cold air moves into the area, and brings freezing temperatures for days and weeks without a break. Significant wind occurs as a cold front moves in bringing deep penetrating freezing

to plant and substrate. This can be a prolonged event. It is difficult to protect crops from injury when these conditions occur unless a heat source is available. Bag crops situated on the ground rather than on a table top are less at risk as are those protected by a mulch, snow or any form of wind protection.

Crops are commonly mulched with straw in North America, where winters are colder and drier than those in the UK. However, a typical wet British

winter would greatly increase the risk of crown rotting under a straw mulch.

Frost

A radiation frost occurs during still conditions when skies are clear at night, allowing ground and near ground temperatures to drop below freezing. This can be a short lived event lasting several days at the most. A protective mulch can successfully prevent damage.

Practical protection options

There are various options open to growers to protect substrate crops from cold injury. These are listed below (in order of reliability at protecting the crop):

- Move crops into a permanent structure with heating capability for frost protection, although this

is not practical for many growers

- Move crops into a permanent unheated structure which is strong enough to survive winter weather conditions
- Place table top crops on the ground, wrapped in fleece

- Leave table top crops raised but wrapped in fleece

Moving and wrapping crops incurs significant labour costs. Growers may not be able to achieve the best protection for all crops, so priorities should be set.

Much experience was gained from winter 2010/11 and previous years that can provide a useful guide. This can be separated into guidance for growers who choose to store their crops at ground level and those who store on table support structures.

The following guidelines will help growers to consider the range of options available to them. Not all of them will be feasible or economically viable for everyone, but growers can choose the most appropriate for their particular business.

Best practice and considerations for ground located troughs and bags

- Decide on the over wintering height. This is a significant protection factor. Some systems are almost ground based, e.g. on draining mats or raised wires. These are sufficiently close to the ground to benefit from the daytime heat reserves and minimal wind chilling and do not need to be moved. Table top crops are always best lowered to the ground for these reasons, though this may not be an economic

possibility for all farms.

- Place troughs and bags onto free draining ground. Waterlogged compost freezes around the roots and is more likely to result in cold injury than drier compost.
- Fleeced crops can stay wet for longer. Several weeks of soggy foliage will develop botrytis. This disease will slowly rot the tops of the crowns. Keep checking for this on a weekly basis and remove the covers to allow drying out if this becomes apparent.
- Ensure the canopy is free of pests before covering. Fleecing of a crop provides protection from the cold, but will encourage pest development in mild spells. A high volume crown penetrating spray of chlorpyrifos or lambda-cyhalothrin is temperature insensitive and will kill aphids and caterpillars. You may consider adding a botryticide and slug protection.
- Control grass and weed growth around the crop. A fleeced and sheltered area will encourage weed growth through winter. Place a permeable membrane

between the ground and the crop. A layer of fleece or woven polypropylene is sufficient as the closely placed bags also suppress weed growth (Figure 5).

- Reducing the surface area of bags and troughs exposed to the wind will reduce potential injury. Positioning bags and troughs side by side will achieve this (Figure 5) and containing them within a perimeter of straw bales or bunched fleece/polythene will further help to reduce the edge effect of wind chilling. Consider placing a polythene sidewall down a windward edge, remembering that cold air also needs to drain away.
- Prepare for prompt action when the medium range weather forecasts predict a spell of cold weather. The time required to cover can be minimised with advance preparation. Lay the fleece and/or polythene mulch along the alleys ahead of winter and prepare a method of anchoring the covers (e.g. bags of soil). Keep rain off the fleece. Preceding cold, wet conditions can create unmanageable frozen or soggy fleece at covering.
- Trials have shown that two layers of fleece give slightly better protection than a single layer of double density fleece. They simply trap more air for insulation. If possible, avoid using dirty, weed seed infested fleece.
- Watch out for vermin during winter. Rabbits may never have been a problem for table top sites, but will now be within reach.
- Consider the need for water access. Drought can be a risk in some winters, though plants are able to tolerate several weeks in relatively cold dry compost, just as commercially cold stored tray plants do. Typical British winters tend to have wet spells and the risk of desiccation is low unless there is much growth under the fleece. Holed polythene covers would be more difficult to penetrate with overhead irrigation, if drought was encountered.



5 Choose a free draining site. Avoid long grass, bare soil is better; obstruct potential emerging weeds with fleece or other membrane. Place troughs side by side to reduce cold edges. Cover with fleece layer(s). Leave as much leaf debris on the crop as you can; trapped air is an excellent insulator.

Best practice for table top located crops

The same principles apply for table top protection. Table tops are significantly exposed to wind run and experience more rapid freezing. A double layer of fleece is most important. The extra layers simply trap more air into the protective layer. Wrapping loosely bunched fleece over the top and sides of bags with an outer layer of permeable polythene would enclose an air volume with the greatest insulation.

However should the season dictate, be aware that such protection is hard to remove and reinstate when compared to ground located crops. Avoid covering too soon or soft growth may occur. Covering is likely to be required in late October at the earliest. It would be possible to partially slash the fleece protection rather than remove it if there is an unexpected mild spell.

Remember that table top crops can survive freezing, though the increased exposure to wind is a serious threat. Bear in mind that complete frost protection is not desirable; cold is needed to maintain dormancy. Strawberries are a hardy perennial and capable of surviving most British winters unaided.

Timing of covering

- **Encourage full dormancy.** Allow the crop to harden off before covering as soft tissue is the most easily damaged. Dormancy is reached around the beginning of November at the earliest; several normal frosts will be an advantage to harden the crowns before protection is put in place. Use of a max-min thermometer between the bags in the lowest most frost prone area will provide a better insight. Short frosts of around -5°C are not harmful.



6 Holed polythene 'lay flat' over single thickness fleece gives good temperature and wind protection

- **Avoid breaking dormancy.** British winters can turn mild, and covered crops begin to grow if not monitored frequently. Inspect crowns regularly through the winter. Dormant plants have the best physiological defence against cold damage. Crowns can also rot with Botrytis when exposed to prolonged damp conditions under fleece. As soon as the weather becomes milder, remove one layer but leave a single fleece for longer if needed. Winter protection should never be allowed to accidentally advance crop development in spring. It is likely that any serious prolonged cold risks are over by mid February.

Types of cover

Covering reduces the rate of heat transfer; it slows the rate of freezing. Prolonged freezing conditions ultimately chill through all defences.

A single layer of fleece will protect strawberry plantings from several degrees Celsius of frost.

Loose straw is an unlikely option for British crops as it is slow to apply and remove. It will also hasten crown rotting if there is a lot of cold wet weather.

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