



UVASYS

Keeping grapes fresher for longer



AgroFresh

www.agrofresh.com

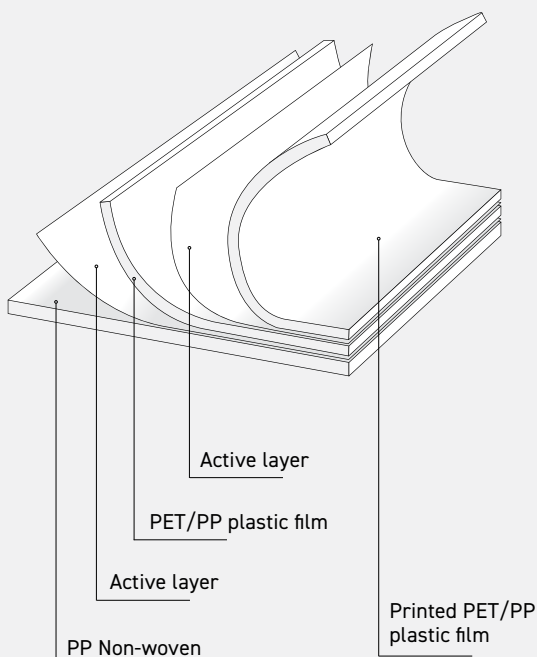
INTRODUCTION TO AGROFRESH

AgroFresh is the global leader in delivering innovative post-harvest solutions that answer real business challenges every step of the produce supply chain. With 40+ years of innovation, AgroFresh was the first to introduce 1-MCP technology for ethylene management with SmartFresh™, as well as developing Uvasys™, the leading laminated SO₂ generating sheet designed to protect table grapes from post-harvest fungal decay. AgroFresh offers digital monitoring, intelligent packing solutions, and plant-based coatings. They empower growers, packers, and retailers to deliver quality produce worldwide.



WHAT IS A UVASYS SO₂ SHEET?

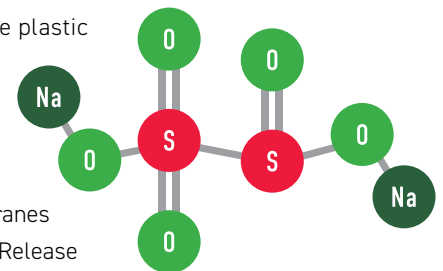
Uvasys consists of a sequence of laminated plastic membranes in either dual-release or single-stage release, each bonded by a layer containing precise concentrations and particle sizes of sodium metabisulfite Na₂S₂O₅.



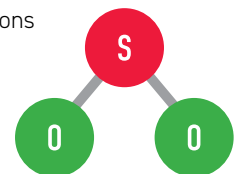
SODIUM METABISULFITE

An inorganic compound of the chemical formula Na₂S₂O₅ sometimes referred to as sodium metabisulfite. On contact with water (H₂O) vapour, expressed as relative humidity, sodium metabisulfite releases sulphur dioxide: SO₂, the primary active ingredient of our products.

The top and middle membranes sandwiches the Slow-Release layer. The middle and bottom membranes sandwich the Fast Release layer. At 70% and above relative humidity, an autocatalytic reaction is initiated, whereby the sheet starts releasing a time and concentration-varying stream of SO₂.



Sulphur dioxide, SO₂, is a colourless gas with a sharp, salty smell. It is particularly effective against *Botrytis cinerea* and functions as a preservative. To note: SO₂ is heavier than air and will always gravitate towards the bottom of a container or area.





The quantity of SO₂ emitted is critical to the product's efficacy. An excessive release of SO₂ can cause bleaching, while an insufficient release may not prevent the development of fungal decay.

This graph is for illustrative purposes only and shows the release of Uvasys DR B

HOW DOES IT WORK?

The **Fast Release** disinfects the surface of the grapes, by releasing enough SO₂ over a 24-to-48-hour period to kill and eliminate any actively growing *B. cinerea* fungal spores and mycelia.

The **Slow-Release** layer remains active for up to 120 days. It emits a low, continual dose of SO₂ gas, concentrated enough to inhibit any superficial latent *B. cinerea* spores from growing but also low enough

to ensure sulfite residues within the table grapes remain safely below the legal limit of 10 ppm. Infection at flowering could still develop but will be contained to the affected bunch.

The quantity of SO₂ emitted is critical to the product's efficacy as an excessive release of SO₂ can cause bleaching, while insufficient release may not prevent the development of *Botrytis*.

For more detail on the chemical reactions please visit the Research page at www.agrofresh.com

Product	SO ₂ Release	Recyclable	Sheet Size (mm)	Packaging Type
 <p>Dual Release Green A fast release (first stage) and slow release (second stage). Use pad after periods of rain or prolonged wet periods. Use pad suitable for thick skin grape cultivars.</p>	Dual Release Fast >48hr Slow >120 Days	n/a	356 x 260	4.5 kg Carton
			460 x 260	5 kg Carton
			460 x 350	8.2 kg Carton
			530 x 350	9 kg Carton
 <p>Dual Release Blue A fast release (first stage) and slow release (second stage), specifically developed for cultivars that show sensitivity (thin skinned) to SO₂.</p>	Dual Release Fast >48hr Slow >120 Days	n/a	356 x 260	4.5 kg Carton
			460 x 260	5 kg Carton
			460 x 350	8.2 kg Carton
			530 x 350	9 kg Carton
 <p>Dual Release Blue Recyclable The first recyclable SO₂ generating sheets based on the same formulation as Uvasys DR Blue will however last for 70 days.</p>	Dual Release Fast >48hr Slow >70 Days	✓	356 x 260	4.5 kg Carton
			460 x 260	5 kg Carton
			460 x 350	8.2 kg Carton
			530 x 350	9 kg Carton
 <p>Slow-Release Is a second stage only (slow release) product which releases a continuous low dose of SO₂, suitable for growers pre-gassing their grapes prior to packing.</p>	Slow Release >120 Days	n/a	356 x 260	4.5 kg Carton
			460 x 260	5 kg Carton
			460 x 350	8.2 kg Carton
			530 x 350	9 kg Carton
 <p>Fast Release Economic Is a single-stage SO₂ short term product, providing a first "peak" stage only. Product provides a maximum of 20 days cover under optimal conditions.</p>	Single Release Fast >48hr	n/a	356 x 260	4.5 kg Carton
			460 x 260	5 kg Carton
			460 x 350	8.2 kg Carton
			530 x 350	9 kg Carton
 <p>Fast Release Recyclable A fully recyclable short term sheet. It consist of a fast release stage only and remains active for up to 12 days.</p>	Single Release Fast >48hr	✓	356 x 260	4.5 kg Carton



KNOW YOUR ROT

Rot Type	Symptoms	Infection
** <i>Rhizopus</i> (Soft Rot)	Grey fluffy sporangioophores grow outward from wounded areas, causing berries to gradually shrivel up.	Fast growing infection that feeds off the sugars present in the grape berries.
** <i>Alternaria</i> rot	Causes black lesions on grape berries. Green/brown mycelia grows from the black lesions.	Reproduces asexually. Infection develops from cracks and wounds.
** <i>Penicillium</i>	Primary infection is white. Turns into a blue-green mould. Decayed tissue is soft and watery.	Infects at wounds on the berry. Reproduces asexually. Infects through conidia that are distributed by wind.
<i>Botrytis</i> (Grey Mould)	Causes brown spots on leaves. Infected berries are covered with white fluffy growth that turns grey. Also causes 'slip-skin' on table grapes.	Causes infection on wounded berries. Infects through spores that are distributed with the wind/water droplets.

**Efficacy against pathogens with Uvasys not proven yet.
The table provides information on other pathogens present on table grapes.

FAQ'S

What is the legal limit of sulfite residue?

This is a broad question but focusing on the legislation in effect within the EU (Referred to as Harmonised Legislation, meaning all EU and EEC members use the same rule set) and only looking at table grapes, blueberries and litchis; MRLs (Maximum residue levels) are set at 10 ppm (parts per million), meaning more than 10 ppm detected on fruit is more than the allowed level, thus illegal. Less than 10 ppm is allowable.

What SO₂ concentrations are emitted by Uvasys sheets?

Depending on the product, the level of dosing varies over time and per phase, but with the most widely used product, Uvasys Green, there are 2 phases of SO₂ release (dual release). The first is a high level of SO₂ release within a short period of time (Uvasys Green 160 – 180 ppm and Uvasys Blue 120 – 140 ppm) over 48 hrs. This kills off active *Botrytis* growth within the confined environment. The second release curve is a slow, trickling, release of SO₂ in the range of 5 ppm for up to 120 days. This stops latent *Botrytis* growth from developing.

How do you test for SO₂ residues on table grapes?

The most common method of testing is the Optimized Monier-Williams method. Most laboratories that offer fungicide residue testing should be able to provide this test as well.

How quickly does SO₂ break down in the fruit?

This is a difficult question as there are multiple factors affecting the breakdown curve of SO₂. The short answer is that SO₂ and sulfites (the chemical that presents as the allergen) metabolises inside grape berries to form sulfate (salts that are non-allergic). The rate at which this happens is very fast (+/- 4 Hrs), and you can find the detail of this study in the following paper: Metabolic responses to sulfur dioxide in grapevine (*Vitis vinifera* L.): photosynthetic tissues and berries Michael J. Considine and Christine H. Foyer <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4335272/>

Where in the sheet is the SO₂?

Our products do not actually contain SO₂ or elemental sulfur as a raw ingredient. SO₂ is generated by means of an autocatalytic chemical reaction between water (H₂O) and sodium metabisulfite. Please look at the Products page in conjunction with the Research pages.

Can I use Berrisys on Grapes if I don't have Uvasys in stock?

This is not recommended. The reason is that Berrisys and Uvasys have different formulations of sodium metabisulfite and other components which regulates the release curves. The biggest of these are temperature mapped curves. Because the reaction to produce SO₂ is autocatalytic the release curves change when the temperature changes. Different products are not usually stored and transported at the same temperatures, so using sheets not designated for the intended produce will not only put you and your product at risk, but also void any warranty we provide.

Is it safe to eat bleached table grapes?

Completely! It just might not taste as expected.

If the release of SO₂ is affected by temperature, what happens when there is a mechanical problem with my container?

For each 5° Celsius rise in temperature, the SO₂ release will double. Usually, this will happen during the second phase of the release curve, and the effects will be minimal. However, if the temperature during transit jumps drastically and for an extended period, the effects will be noticeable. You could find bleaching, and a slight reduction in the release window. Its not easy to quantify, and each case should be inspected individually.

I found some old sheets from a few years ago. Are they still good to use or should I throw it away?

Our sheets are stable when stored correctly. Sheets that had been forgotten for over a decade still worked when tested. The first thing to do is ensure the storage bag is still sealed and intact. Next, find the batch number and forward this to us, stating the conditions of storage and integrity of the bags. You're welcome to send samples to our QC department for testing and comparison with acceptable specifications.

What is bleaching?

Bleaching occurs when SO₂ bonds with water. This is usually on the surface of the produce where condensation formed droplets. When enough SO₂ dissolved into these droplets they become acidic, forming a mild sulfuric acid. This in turn then bleaches the affected area and the colour is removed, just like household bleach when spilled onto your favourite jeans.

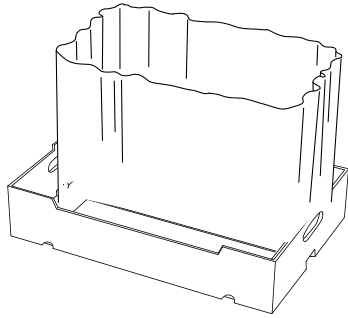
UVASYS TIPS

- Please note that the optimum ventilation type and size will depend on your unique combination of: Production area; Cooling systems; Post-harvest handling times; Pack type (loose, punnets, carry bag, etc)
- Once grapes are placed inside the liner bag, punnets and clamshells (heat sealed or open top), Zip-lock bags, polycote bags, carry bags or loose packed grapes may be used
- Please remember, when using open top punnets please ensure there is a minimum of 10 mm headspace. If this is not achievable, make use of side-ventilated punnets
- Use a MAM on top of the Uvasys sheet if you are expecting excessive condensation
- Recommended packing fruit pulp temperature <math><25^{\circ}\text{C}</math>
- Use the correct size Uvasys sheet for the carton size
- Use the correct type Uvasys sheet for the pack style and grape cultivar
- We recommend the use of an appropriate hydrophobic top sheet for sensitive cultivars, and also for when growers experience challenges with condensation
- Do not pack damaged/bruised/wet grapes
- Do not break the cold chain as this negatively affects table grape quality
- Uvasys Dual Release & Fast Release Recycled sheets are made with Polypropylene (PP) and are fully recyclable



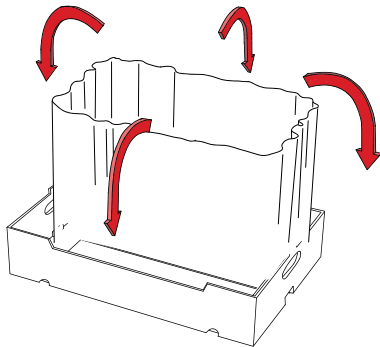
UVASYS BULK PACKAGING INSTRUCTIONS:

STEP 1



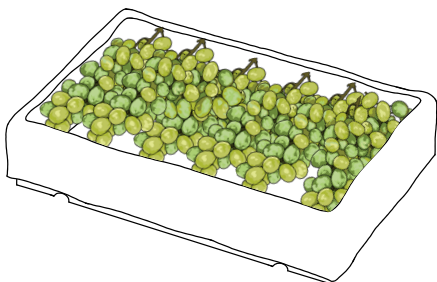
Line the carton with a ventilated liner bag. Fold open the liner bag once correctly positioned inside the carton.

STEP 2



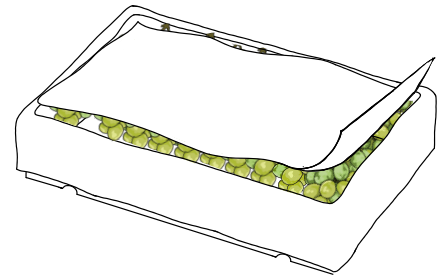
Fold the liner bag around the outside of the carton.

STEP 3



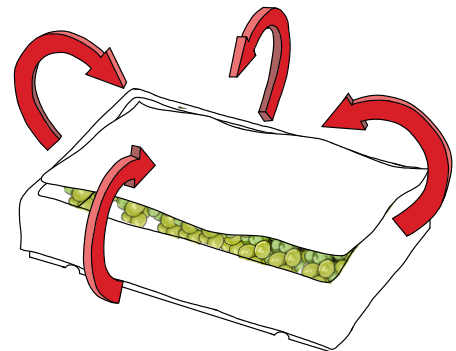
Place grapes inside the liner bag.

STEP 4



Place the UVASYS sheet on top of the grapes, with the printed side facing up. Please note: Uvasys needs a minimum of 70% Relative Humidity to activate and using a liner bag will also limit moisture loss.

STEP 5



Fold the plastic liner back over the contents. Close and cool to -0.5°C as soon as possible.

Please Note:

Always use the Uvasys sheet recommended for the corresponding carton size.

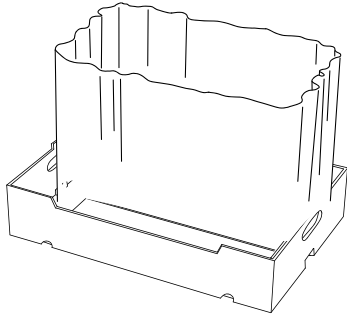
Suggestion: We recommend the use of an appropriate hydrophobic top sheet for sensitive cultivars.

STORAGE INSTRUCTIONS:

- Store Uvasys sheets in the sealed, original packaging in a cool (below 25°C) dry area, out of direct sunlight
- Unused Uvasys sheets can be used the next season if stored correctly in resealed plastic bags
- Each sheet has a printed Batch Number for full traceability

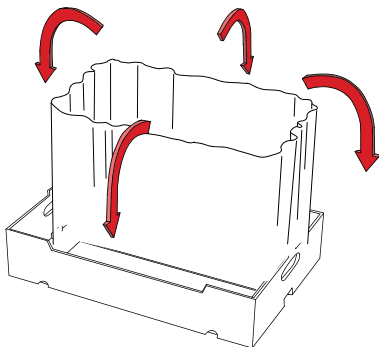
UVASYS PUNNET PACKAGING INSTRUCTIONS:

STEP 1



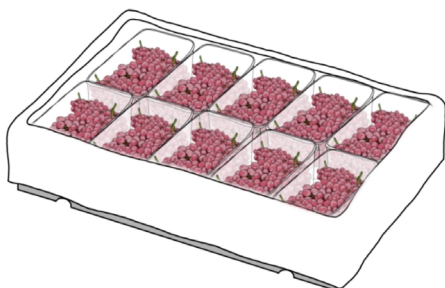
Line the carton with the ventilated liner bag.

STEP 2



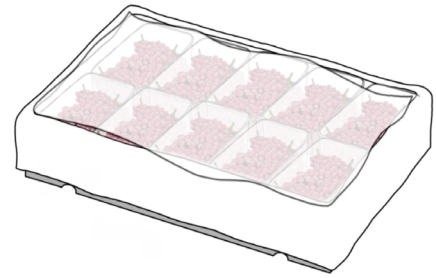
Fold the liner bag around the outside of the carton.

STEP 3



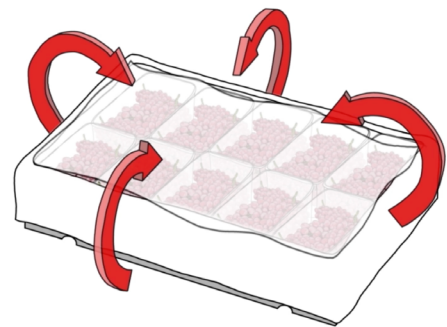
Place punnets inside the liner bag.

STEP 4



Place the Uvasys sheet on top of the punnets, with the printed side facing up. Please note: Uvasys needs a minimum of 70% Relative Humidity to activate and using a liner bag will also limit moisture loss.

STEP 5



Fold the plastic liner back over the contents. Close and cool to -0.5°C as soon as possible.

Please Note:

Always use the Uvasys sheet recommended for the corresponding carton size.

Please ensure a minimum of 10mm headroom when using open-top punnets.

If this is not achievable, please use tissue paper (25g or higher) beneath the Uvasys sheet or make use of side-ventilated punnets.

Suggestion: We recommend the use of a MAM above the Uvasys sheet and/or an appropriate hydrophobic paper sheet for sensitive cultivars and for when you are expecting excessive condensation.

STORAGE INSTRUCTIONS:

- Store Uvasys sheets in the sealed, original packaging in a cool (below 25°C) dry area, out of direct sunlight
- Unused Uvasys sheets can be used the next season if stored correctly in resealed plastic bags
- Each sheet has a printed Batch Number for full traceability

AgroFresh

CONTACT US

www.agrofresh.com

info@agrofresh.com

FEBRUARY 2024

