F-CLEAN™

Greenhouse Film

Bringing the Sunshine Inside

AGC

Your Dreams, Our Challenge

Introduction to F-CLEAN™

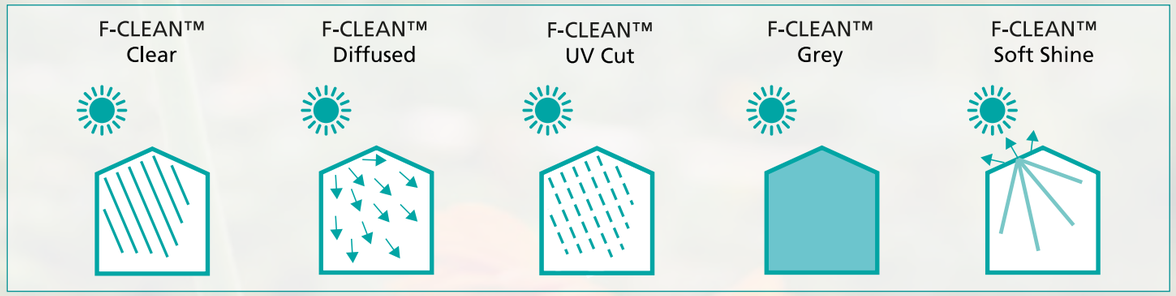
F-CLEAN™ is a fluoropolymer (ETFE) film which improves the growth efficiency of fruits, vegetables and plants inside greenhouses. This film has a higher transmission rate of light and UV than glass, polyethylene or polycarbonate, allowing the full spectrum of solar light to pass through into the growing area. This results in more production, earlier blooms and more colourful petals, as well as sweeter fruit and better quality vegetables.

F-CLEAN™ is treated with an anti-drip coating, preventing water drops from forming and potential drip damage to the crop. Due to the low surface energy of the fluoropolymer film, dirt gets washed away easily by rain and snow, so excellent light conditions can be expected year-round.

- Remains naturally clean for years due to its low surface energy properties
- Excellent UV light transmission (up to 90%) – also available in a ‘UV Cut’ version
- Excellent durability due to minimal effects of ageing on tensile strength – over 30 years’ service life
- Lightweight but strong, requiring minimal structural support
- Self-extinguishing – tested to fire safety standard DIN 4102, Class B-1

F-CLEAN™ Product Range

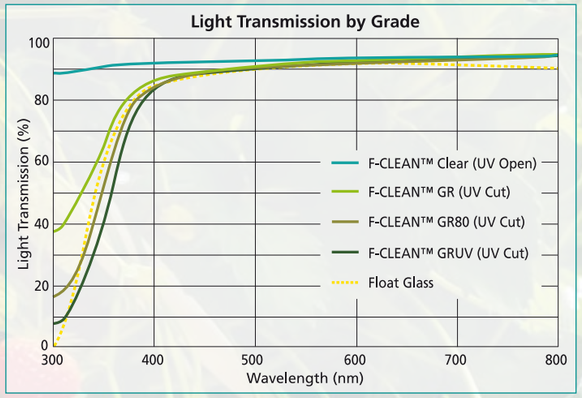
F-CLEAN™ Clear (UV Open)	Uses the full spectrum of solar light and provides the same light conditions as outside.
F-CLEAN™ Diffused	Diffuses light evenly, whilst maintaining high light transmission.
F-CLEAN™ GR Series (UV Cut)	Available in 3 grades with different rates of UV Cut.
F-CLEAN™ Grey	Cuts solar light up to 99%.
F-CLEAN™ Soft Shine	Blocks heat energy from sunlight transmitting 14% light.

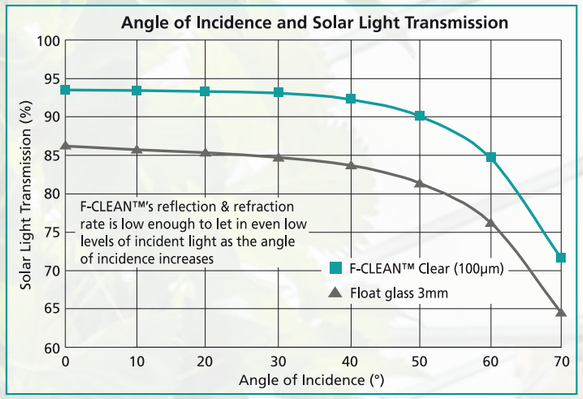


F-CLEAN™ Clear (UV Open)

- Enables extremely high light transmission
- Highest UV transmission of all greenhouse covering materials
- Allows the full spectrum of solar light, resulting in healthy crops and vivid colours
- Excellent light transmission at all angles of incidence

Performance





Test method
1. Measure all spectrums (diffused and direct light) in wavelength region 300nm-2100nm.
2. Calculate the rate of light transmission by measuring the results of step 1 based on JIS-R3106.

Applications

- Crops requiring anthocyanin such as aubergines and strawberries
- Greenhouses growing high quality and/or high added value crops
- Compost houses (animal manure and food leftovers)
- Drying houses (e.g. salt, fish and plums)
- Improved honeybee pollination

Seedlings

Aubergines

Strawberries

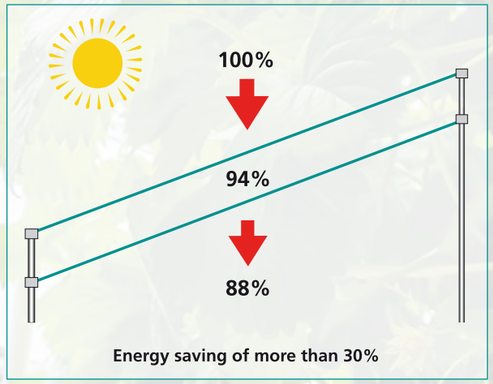
F-CLEAN™ Clear

Performance

- Improved colours
- Prevention of internode elongation
- Excellent durability – life span over 30 years
- Installing a double layer provides increased thermal insulation, reducing heating costs

Double Layer Projects

Provides very high thermal insulation and light transmission.



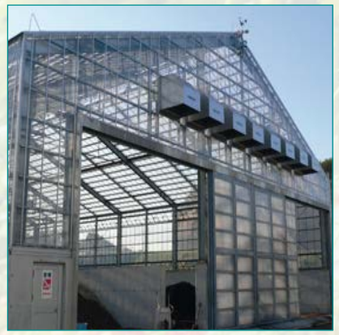
Energy saving of more than 30%

Coefficient of heat transmission:
6.6W/m² · K (single layer 100μm); 3.8W/m² · K (double layer 100μm + 60μm)

* Measurements based on AGC's test method

Non-Agricultural Applications

- Fermentation facilities for composting
- Greenhouses for drying fruit



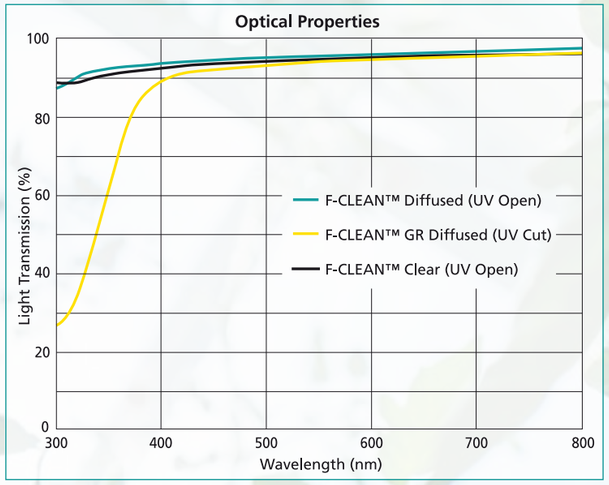
Composting fermentation facility

Hothouse for drying plums

F-CLEAN™ Diffused

- Diffuses light evenly, eliminating shadows
- Extremely high haze level of 60 – 70%
- Condensation does not negatively affect the light transmitting. If condensation forms on the film's matte surface, the surface changes to clear.
- Enhancement of overall photosynthetic capacity
- Available in two grades: Clear and GR (mild UV cut)

Performance

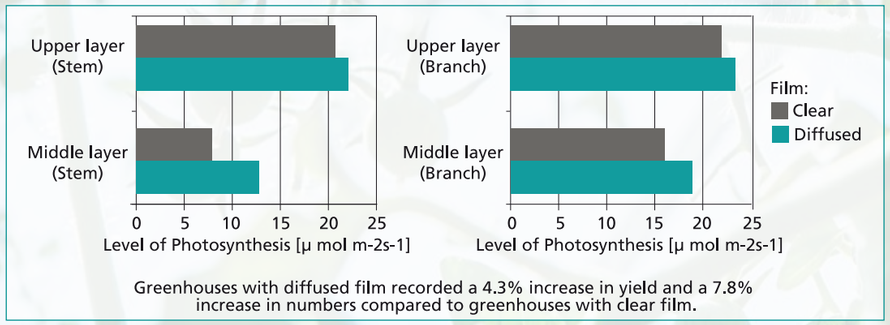


Comparison of F-CLEAN™ Clear and Diffused

F-CLEAN™ Clear

F-CLEAN™ Diffused

Tests done by the Dutch Agricultural Research Institute Wageningen University

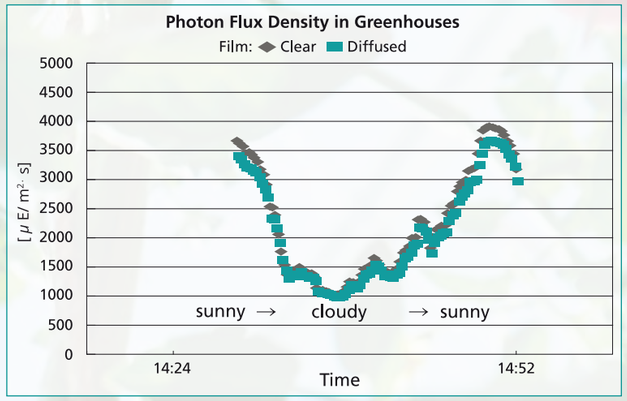


Greenhouses with diffused film recorded a 4.3% increase in yield and a 7.8% increase in numbers compared to greenhouses with clear film.

F-CLEAN™ Diffused

Photometer Data

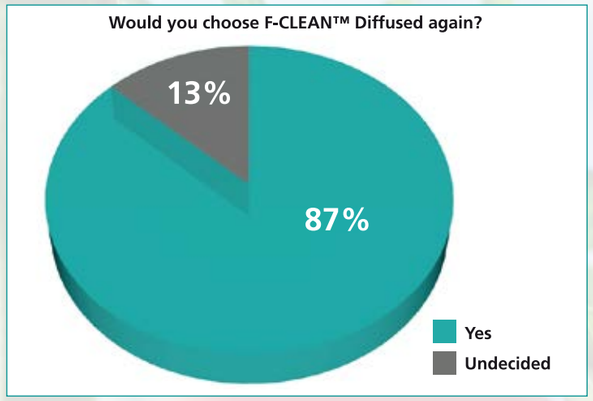
Location of measurement: Kochi, Nankoku-shi, Japan



The photometer results show no difference in photon levels of clear film and diffused film whether the weather is sunny or cloudy.

Note: Photometer: Equipment which measures light transmission of photons with an angle of incidence of 270°

Customer Satisfaction Survey



Case Studies

Grade: 60μm Diffused
Crop: Strawberries
Location: Tochigi

Grade: 80μm GR Diffused
Crop: Chrysanthemums
Location: Ibaraki

Grade: 80μm GR Diffused
Crop: Tomatoes
Location: Aichi

Note: The full benefits of F-CLEAN™ Diffused may not be realised with certain conditions or crops.

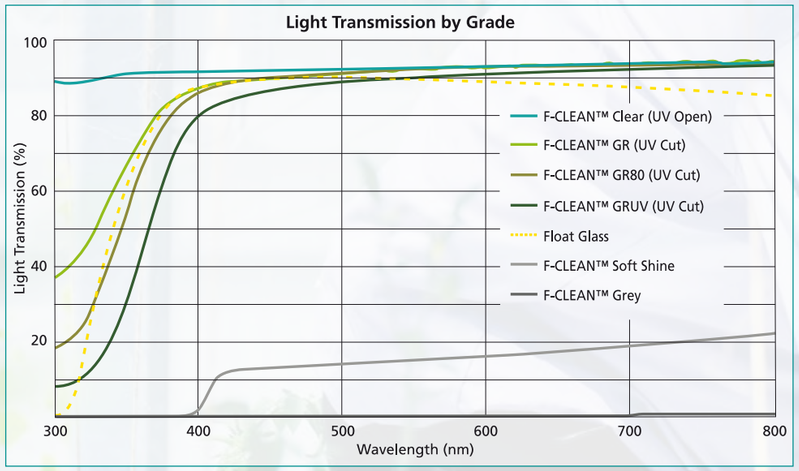
F-CLEAN™ GR Series (UV Cut)

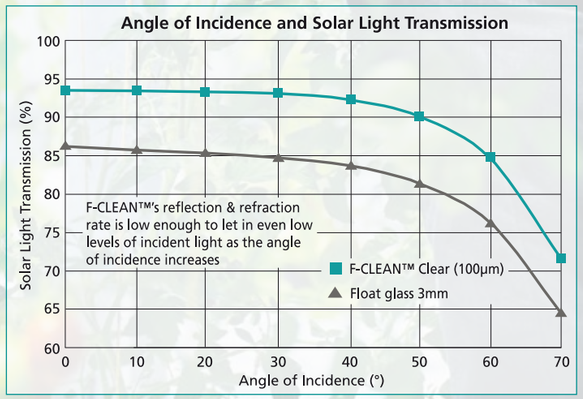
- Three grades of UV cut film are available to suit the needs of different plants
- Protection of materials and tools from UV damage
- UV cut function does not deteriorate over time

F-CLEAN™ GR Product Range

- F-CLEAN™ GR provides low UV cut (clear/diffused)
- F-CLEAN™ GR80 provides UV cut properties similar to glass (clear)
- F-CLEAN™ GRUV provides the highest UV cut in the F-CLEAN™ series (clear)

Performance





Test method
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Crop Examples

GR

Cyclamens

Melons

GR80

Tomatoes

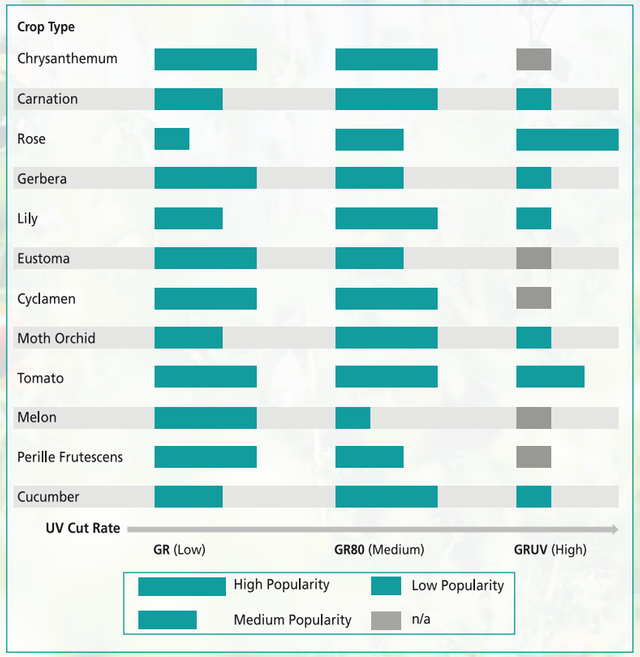
Spray Chrysanthemums

GRUV

Roses

Roses

Usage Trends of the GR Series

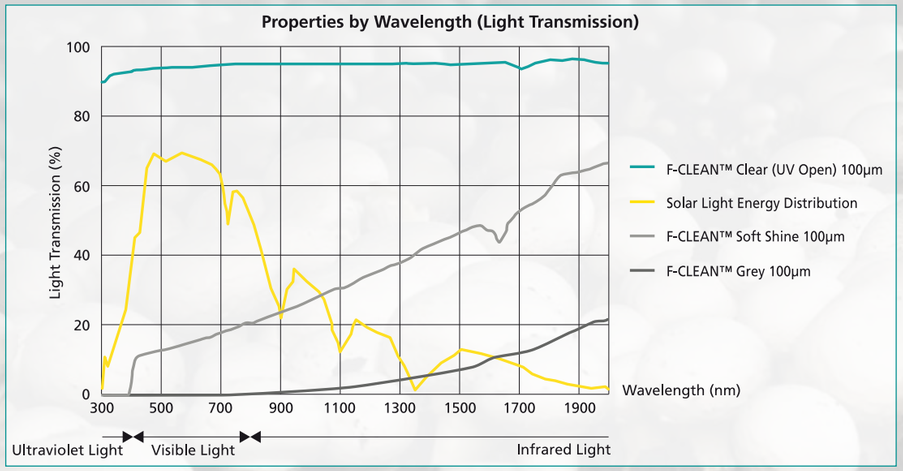


Note:
- Honeybees may behave differently under UV cut conditions – professional bee keeping advice should be sought
- Care should be taken when using F-CLEAN™ GR grades if the crop colour relies on anthocyanin

F-CLEAN™ Grey

- Cuts over 99% of visible light, providing a cool environment even in hot weather
- Blocks heat energy from solar light, which prevents the internal temperature from rising
- The solar heat gain coefficient is 24%, equivalent to that of F-CLEAN™ Soft Shine
- Excellent weatherability and chemical resistance
- High absorption of infrared light which helps snow slide off the roof
- Standard dimensions: 100μm x 1300mm x 50m with anti-dripping treatment
- The film can be welded if wider dimensions are required
- Special repair tape is available for F-CLEAN™ Grey

Performance



Applications

- Factories with artificial light only
- Mushroom cultivation
- Animal housing
- Warehousing
- Sports facilities
- Sewage disposal facilities

Irrigation room

Machinery warehouse

Animal housing*

*covered with alternating F-CLEAN™ Clear & F-CLEAN™ Grey

Fish farm facility

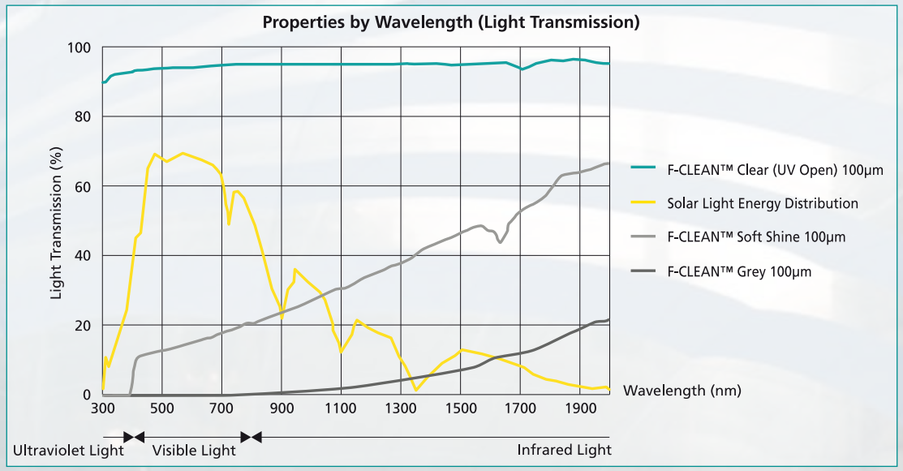
Mushroom cultivation

Sewage disposal facility

F-CLEAN™ Soft Shine

- Enables light transmission of about 14%, whilst blocking heat energy from solar light to prevent temperature build-up
- The solar heat gain coefficient is 24%, equivalent to that of F-CLEAN™ Grey
- Excellent weatherability and chemical resistance
- Cuts UV completely as well as infrared rays
- Standard dimensions: 100µm x 1300mm x 50m with anti-dripping treatment
- The film can be welded if wider dimensions are required

Performance



Applications

- Mushroom cultivation
- Animal housing
- Sheds/Warehousing
- Sports facilities

Mushroom cultivation

Animal housing*

*covered with alternating F-CLEAN™ Clear & F-CLEAN™ Soft Shine

Shading for stores

Delivery facility

Swimming pool

Fluon® ETFE Film is also used as a covering material for sports facilities

Delivery facility

EMEA Regional Projects

F-CLEAN™ greenhouse film can be used at extreme temperatures ranging from -100°C to 150°C. This makes it suitable for use in all types of climate, from the long, cold winters in Russia to the dry and dusty heat of Egypt. F-CLEAN™ has been used successfully for years in both these locations, as well as in many others, including Austria, Belgium, France, Germany, Italy, Jordan, Netherlands, Qatar, Switzerland and the UK.

Location: Switzerland*
Area: 10,000m^2 + warehouse
Type: Venlo 9.6m
Crop: Young plants, vegetables & lettuce
Covering: Single layer F-CLEAN™

Location: Austria*
Area: 15,000m^2 + warehouse
Type: Venlo 9.6m
Crop: Herbs
Covering: Single layer F-CLEAN™

Location: France
Area: 11,232m^2
Type: PV greenhouse
Crop: Strawberry
Covering: Single layer F-CLEAN™

Image courtesy of ArtigianFER

Location: Egypt*
Area: 10,000m^2
Type: Wide Span 9.60m
Crop: Sweet pepper & tomatoes
Covering: Single layer F-CLEAN™

*Images courtesy of VDH Sustainable Greenhouse Solutions

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