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Covering materials

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The two most important environmental parameters that represent the climate of the greenhouse are light and temperature. Both of these are strongly influenced by the type of covering and its properties.

G. Connellan, 1998

CROP PROTECTION

The greenhouse provides growers with the potential to modify the environment in which plants are grown. This includes conditions necessary for growing crops (temperature, light, humidity, water and air movement) and the conditions to better manage pests and diseases.

Greenhouse coverings can be divided into four groups:

- glass
- plastic sheeting
- plastic films
- protective screen fabrics.

GLASS

Glass has long been the traditional covering. Its favourable properties include:

- high PAR* transmission
- good heat retention at night
- low transmission of UV light
- durability
- low maintenance costs.

The biggest draw-back of glass is the initial cost, though it has been demonstrated that over a period of time (10+ years) the cost of glass compares favourably with other materials.

PLASTIC SHEETING

Essentially there are three materials in this category—polycarbonate, acrylic (polymethyl methacrylate) and fibreglass. Plastic sheeting is not used extensively in New South Wales (other than around the family home). Sheeting products are more durable than plastic films and have fairly good heat retention, good initial transmission in the PAR range and low UV light transmission.

PLASTIC FILMS

Films are the most common and lowest cost type of covering material. The types of film available are polythene (polyethylene), EVA (ethyl vinyl acetate) and PVC (poly vinyl chloride).

Additives to the plastic determine its:

- durability
- capacity to reduce heat loss
- capacity to reduce droplet formation
- transmission of particular wavelengths of light
- capacity to reduce the amount of dust sticking to the film.

Types of additives

1. UV (290–400 nm) absorbers and stabilisers increase durability, reduce the potential damage to biological systems in the greenhouse and may control some plant pathogens.
2. Infrared (700–2500 nm) absorbers reduce long wave radiation and minimise heat loss.
3. Long wave radiation (2500–40000 nm) absorbers reduce the loss of heat radiated from materials and objects (including plants) inside the greenhouse.

* PAR stands for photosynthetically active radiation. This is the part of the light spectrum used for photosynthesis and plant growth. This covers wavelengths from 400–700 nanometres (nm).

4. Light diffusers scatter light entering the greenhouse, reducing the risk of plants getting burnt and improving the amount of light available to the lower parts of the plant.
5. Surfactants reduce the surface tension of water, dispersing condensation.
6. Antistatic agents reduce the tendency of dust to accumulate on plastic films.

In addition:

1. Colour pigments may improve plant growth by altering the proportion of selected wavelength ranges.
2. Fluorescence may be used to increase the emission of red light.
3. Glossy surfaces may repel insects.

A significant recent advancement has been the process of making multilayer films[1]. This enables thin layers of materials with different properties to be joined to make superior composite films.

Properties such as durability, creep (deformation over time) and long wave radiation absorption can be improved.

PROTECTIVE SCREEN FABRICS

There are a number of different materials in this category.

Shade cloth:

- reduces the amount of solar energy entering the greenhouse, which lowers plant stress
- reduces light intensity
- will protect structures from hail damage.

If shading is required, pale coloured materials should be used as these uniformly reflect solar radiation[1]. A range of products exist that offer shading from 30% up to almost total blackout. Whitewash paints are another option that can be applied to reduce the amount of radiation entering the greenhouse.

Solar and thermal screens:

- reduce the amount of solar radiation incident on the crop or
- prevent the escape of long wave radiation from the greenhouse and trap warm air.

The first use allows some radiation to penetrate and reflects the rest. This is used for temperature control during the day. The second type retains energy within the greenhouse and is used at night. Thermal screens are typically drawn over the crop or structure when needed.

Insect-proof screens:

- exclude insect pests, reducing the need for chemicals.

Restricted airflow is the main disadvantage. The type of screen used will depend on the insects to be excluded, for example, thrips require the finest sized screen. Plastic screens eventually suffer from the same UV deterioration as plastic films.

LIGHT TRANSMISSION

Covering materials impact on the level and quality of light available to the crop. Diffused light is better than direct light. Fluorescent and pigmented films can increase the proportion of good red light. Dust, attracted to plastic films, will reduce the transmission of radiation. Water droplets on the inside of coverings have been shown to reduce light transmission by 8%[1] and will also block thermal radiation.

TEMPERATURE

Internal temperature depends on energy entering and leaving the greenhouse. Covers influence this energy flow by transmitting, reflecting and absorbing varying levels of radiation. The volume of air exchanged further influences temperature by moderating the amount of heat energy that can escape. Insect screens will impede air movement.

Some options to improve ventilation include:

- screening only where necessary (e.g., western flower thrips will not move upwards more than a couple of metres, so the finest screen is only needed on the lower part of the structure
- only screen the windward side (many insects are wind borne)
- use insect screening for the greenhouse walls and cover with roll-up poly film where necessary.

DISPOSAL

Disposal of plastic is an increasing problem and cost for the industry that has to be considered.

FURTHER INFORMATION

1. Connellan, G., 1998, *Greenhouse Coverings—Properties and Selection*, published in the proceedings for the National Protected Cropping Expo 1998.

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