

Update on Plastic, Polycarbonate, Acrylic and Glass Coverings

John W. Bartok, Jr.
Extension Agricultural Engineer Emeritus
Department of Natural Resources Management and the Environment
University of Connecticut, Storrs CT 06269-4087

The covering on a greenhouse or high tunnel allows us to provide an environment that enhances plant growth. The main purposes are to allow light energy through and to restrict heat from escaping. It also provides some wind protection.

The amount of light energy that is transmitted through a covering depends on the type of material, orientation and location of the greenhouse or tunnel and the structural design. A comparison of covering materials is usually measured in photosynthetically active radiation (PAR). This includes the light spectrum that our eyes see.

What materials are being used to cover greenhouse/high tunnels?

A recent survey by the National Greenhouse Manufacturers Association showed that for new construction:

10% of are covered with glass,

10% with acrylic,

30% with polycarbonate

46% with polyethylene film

The following are some observations of changes that are affecting the glazings being used.

Glass – Wide pane, tempered glass is standard today. Sheets as large as 6' x 12' can be manufactured and placed on a greenhouse. Aluminum bars with EPDM rubber gaskets are used to seal the edges. The long life and high transmittance are an advantage for high light crops, such as tomatoes, cucumbers and peppers. Except for institutional greenhouses, most glass is used in gutter-connected structures. I don't know of any double pane glass that is being installed. Most glass has one or more energy/shade screens underneath to reduce heat loss.

Acrylic – Available in single thickness corrugated and double wall flat sheets, most of this material is now modified with a percentage of polycarbonate or other plastic to give it better strength and a higher fire rating. The warranty life has now been extended to 30 years. It is available in 8 and 16 mm thickness and in 4' and 6' wide sheets.

Polycarbonate – This is the most common semi-rigid material applied to growing structures. It is available in corrugated single wall material and 8 mm and 10 mm double wall material. Warranty is 10 years or longer. Fire and hail ratings are excellent.

Polyethylene sheets – This is a semi-rigid double-wall material similar in design to polycarbonate (Solexx). It is available in 3.5 and 5 mm and requires more support to keep it

from sagging. The material is white with a light transmission of 70 – 75% and used mostly in garden centers or for low light plants. Useful life is about 10 years.

Fiberglass – This once popular covering is no longer being used. It has been replaced by the stronger polycarbonate material. Besides the wearing of the plastic exposing the fibers, it has a high burn rate increasing insurance costs.

Polyethylene film– This is still the most common covering due to its low cost, ease of application and good life. Advantages include good weathering, several available thicknesses, additives such as condensate control and infrared heat inhibitor. The condensate control keeps the moisture in a film rather than droplets that drip onto the plants. Infrared inhibitor is installed as the inner layer and reduces heat loss at night by 10 – 25%. For windy locations a woven poly, such as Solarig may be a better choice. It has more tear resistance.

Recent advances in polyethylene include photosensitive properties and ultra violet blocking. To date film plastics have been made as three-ply construction with different properties in each layer. New technology is now available to do 5 or 7-ply construction. This allows additional properties to be added. TIF (totally impermeable film) is being applied for soil fumigation. As there are no emission losses, the rate of application can be ½ of that of regular film. This same technology is being researched to use layers with different colors that will repel insects. It may also be developed to allow the outer layers to be removed when they become dirty or weathered. For example weathered poly has as much as 10% less light transmission than new poly. Another application may be to have a poly with a tougher outer skin.

Light diffusion is another property that has recently been added by manufacturers. This increases the amount of diffused light that reaches the plants, reducing scorching and increasing light to lower leaves. It is especially important with crops such as tomatoes, cucumbers and peppers. Research has shown that diffused light also reduces fungal spore development and insect propagation.

Single or double layer poly – for normal high tunnel operation, a single layer is adequate. If you are growing early in the spring or late into the fall and are providing supplemental heat, an inflated double layer is better. It reduces heat loss at night by about 40%. It also reduces the stress at the attachments and the rippling of the plastic on a windy day. Air inflation at ¼” water static pressure is best. A small blower with 100 – 200 cubic feet/minute output is needed. Connect the blower inlet to outside air to reduce moisture build-up between the layers.

Plastic failure – early failure of poly can be attributed to stress as noted above, abrasion on rough surfaces and sharp edges or heat build-up in that area of rafters, purlins and extrusions. Contact with chemicals from pesticides or pressure treated lumber can also affect the life of the plastic. Poly that is left on the tunnel during the winter is subject to cuts from blowing ice especially if there are multiple tunnels adjacent to each other. A scrim reinforce poly may be desirable in this situation.