Spectral Transmission of Some Plastic Greenhouse Coverings

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Plastic materials in the form of films or fiberglass reinforced panels have almost become a rule rather than the exception for greenhouse coverings. Work in England cited by Spice (7) and by Emmert at Kentucky (2) indicated that desirable plant growth could be obtained under several plastic materials. In 1960, White (8) showed that plants grew well under rigid plastic panels in Oklahoma. Briggs (1) evaluated 11 coverings for their effects on summer carnation growth in 1961. He found growth under 5 colors of fiberglass reinforced plastic panels and two films was superior to growth under glass during the evaluation period.

Additional research at CSU (6) showed that carnation production for two crops grown under clear fiberglass was approximately 5% greater than two crops grown under glass. Two crops grown under coral colored fiberglass yielded approximately 5% less flowers than glass. The flower grade under all coverings was similar with coral slightly higher. Further research conducted in 1966 (5) indicated that white frost colored fiberglass was superior to glass or clear PVC for carnation production.

Samples of several materials utilized in previous covering studies at CSU were sent to Iowa State University where spectral distribution and intensity measurements were made (3,4). This preliminary information provides an insight into the intensity and distribution of wavelengths received by plants during the earlier experiments at CSU.

Discussion

The spectral distribution of three coverings used in some of the first FRP studies at CSU (1,6) are

shown in Figure 1. The main differences occur between 400 and 700 mu. Since the clear fiberglass improved growth we might assume that the most desirable wavelength intensities lie between those obtained from glass and those obtained under coral colored fiberglass. It is possible that an increase in transmission of the coral fiberglass in the 450 mu area could enhance plant growth up to that obtained under clear fiberglass. It is also possible that a decrease in the 500-600 mu area would improve growth under glass.

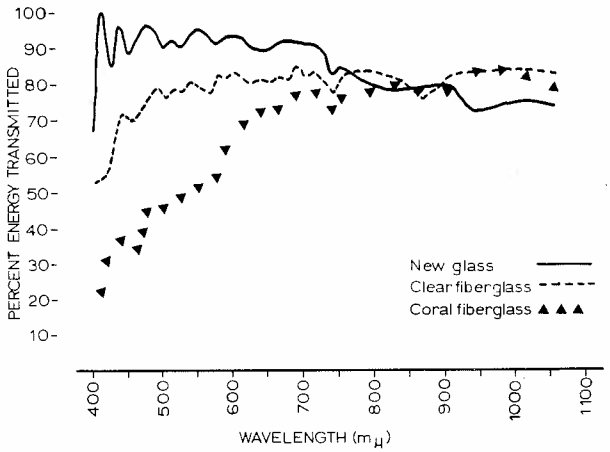

Fig. 1. The percent of unobstructed solar energy transmitted by new greenhouse glass, clear fiberglass and coral colored fiberglass. August, 1966. Ames, Iowa.

The 1966 comparison of production under glass, clear PVC and frost fiberglass can be evaluated in relationship to spectral transmission of each covering in Figure 2. Growth under PVC and frost coverings was similar and better in yield, grade and percent fancy flowers than that under glass. Once again the wavelengths above 750 mu probably had little effect on production. It appears that wavelengths around 400-500 mu may be the major controlling factor. Possibly those closer to 500 mu are most important to growth.

Many greenhouse operators growing under plastic films report that growth is superior to that under glass. Perhaps the reasons are in the spectral intensities and distribution shown in Figure 3. The energy transmitted through polyethylene and fiberglass are almost identical between 450 and 750 mu. Experience has shown that both these coverings provide excellent growth. The 8 mil vinyl film has a greater transmittancy of all wavelengths. Accurate growth measurements under 8 mil vinyl have not been found, but possibly vinyl would be about equal to glass.

Future Work

It is realized that the data taken in Iowa and presented in these figures may not be the same as data obtained at higher altitudes such as Colorado, but it provided a preliminary study of the transmittancy of common greenhouse coverings. These same samples will be studied at Fort Collins using the model SR and SRR Spectroradiometer.

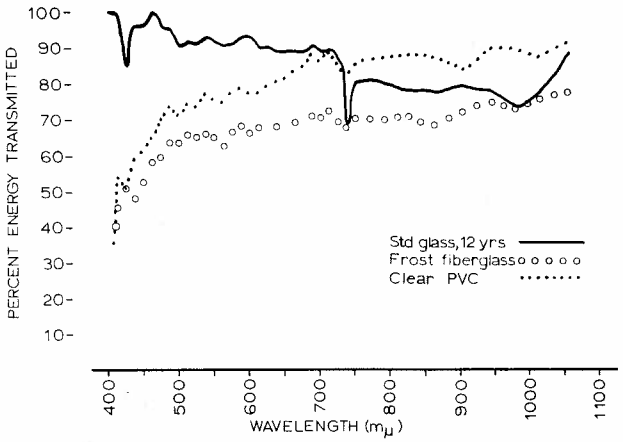

Fig. 2. The percent of unobstructed solar energy transmitted by 12 year old greenhouse glass, white frosted fiberglass and clear PVC. August, 1966. Ames, Iowa.

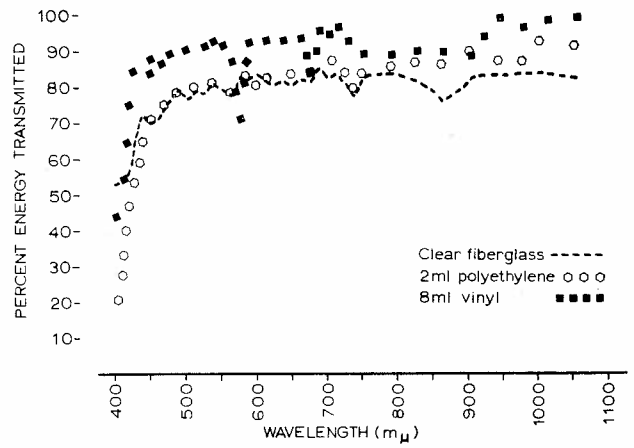

Fig. 3. The percent of unobstructed solar energy transmitted by clear fiberglass, 2 ml polyethylene film and 8 ml vinyl film. August 11, 1966. Ames, Iowa.

It is clear, from previous work at CSU, that better plant growth can be obtained under materials other than glass and research is continuing on greenhouse coverings. We are trying to find the most desirable light transmission characteristics for greenhouse coverings. With the help of industry, we hope to incorporate these desirable qualities in glass and/or fiberglass. It is conceivable that different requirements will have to be determined for at least two altitudes and perhaps for two or more geographical areas based on total yearly solar radiation.

Literature Cited

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