Colorado Flower Growers Association Inc.

IN COOPERATION WITH COLORADO STATE UNIVERSITY

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REFLECTED SOLAR ENERGY FOR WINTER USE IN THE GREENHOUSE

by W. D. Holley and Kenneth L. Goldsberry

Light is most often the limiting factor to plant growth in the greenhouse during winter months. The days are shortest at this time and the angle of the sun is least. The further north or south from the equator, the more acute this angle of the sun becomes.

Approximate true altitude (angle) of the sun at noon on various dates--41° North Latitude.

June 21	74 degrees
July and May 21	71 degrees
August and April 21	63 degrees
September and March 21	51 degrees
October and February 21	40 degrees
November and January 21	31 degrees
December 21	27 degrees

When the sun is low more and longer shadows are cast and much of the solar energy striking a greenhouse either goes on through or is reflected off.

This paper deals primarily with an attempt to salvage some of the energy that ordinarily passes through greenhouses with little beneficial effects to the plants. Other means of using some of this energy, or that reflected from greenhouses, should immediately suggest themselves to thinking growers.

For a number of years we have noted that yield of roses or carnations in an east-west house is greatest for the south bench and decreases with succeeding benches to the north. The usual exception is that the extreme north bench yields better than the second bench from the north side. This correlates with the amount of light striking the various benches. Most modern greenhouse construction casts slightly more shadow on the second bench from the north side.

For several years we have made half-hearted attempts to gain winter light by some sort of reflection. This past year 9 different types of aluminum foil were measured for reflectivity when exposed to a constant light source. Differences of up to 76 per cent were noted in the reflectivity of the different samples.

The most reflective of the samples was obtained in quantity and curtains were placed from the eave to the foundation wall in two greenhouses, with adequate area left without aluminum reflectors to serve for comparison.

The foil used was .0007 aluminum laminated to .0007 polyethylene. This foil is very usable around the greenhouse, is durable and easily stapled to sash bars or other wood members. The price is slightly over 1 1/2 cents per square foot.

Two hundred and four snapdragon plants (varieties Snowman and Cheviot Maid) and 126 calendulas were transplanted to a north greenhouse bench on December 27, 1957. One half of the plants of each kind were in front of a reflector while the other half were not. A buffer zone of approximately half the bench was not used as late afternoon sun reflected from the aluminum could have affected plants in this area.

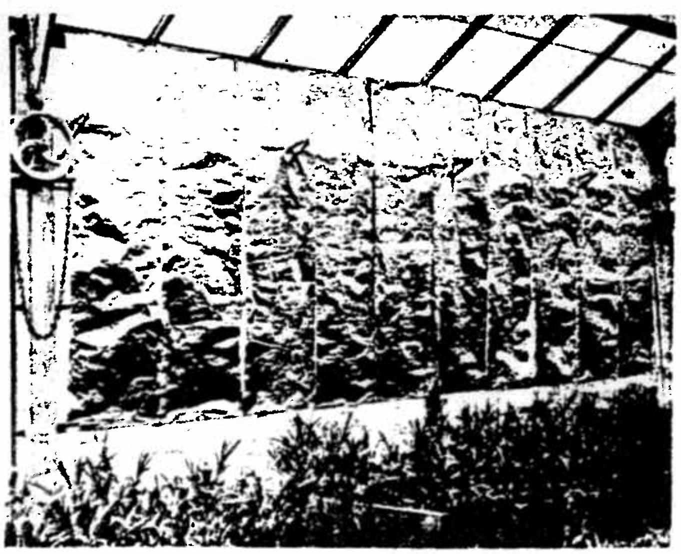
One third of all plants were pulled, their roots washed free of soil and weighed on each of the dates February 6, 19 and March 10, 1958. The plants were dried to constant weight and then weighed again. Height and stem diameter measurements were also taken on the snapdragons on these dates. On March 10, both crops were beginning to flower. No great differences in flowering time were noted. The plants in front of the reflector were approximately one week ahead of the others.

Results

Calendula: The yield in dry matter was 14 per cent greater in front of the reflector on the first two samples, but only 6 per cent greater on the last date.

Snapdragon: The yield in dry matter was increased by the reflector by 34 per cent, 29 per cent and 39 per cent on the three sampling dates. Errors in sampling might possibly account for the variation between sampling dates. The average increase in yield of dry matter in front of the reflector was 36 per cent.

A slight increase in height in front of the reflector of 2.5 per cent was not significant. The aluminum reflector increased stem diameter an average of 14 per cent.



Carnation: A reflector was placed north of the middle third of a carnation mother block bench on December 27. Cuttings were harvested constantly from this bench during January and February, the cuttings in front of the reflector having a firmer feel than those from either end of the bench.

On March 10, six samples of 10 cuttings were taken in front of the reflector and the same number were taken on either end of the bench for comparison. Cuttings grown in the reflected light averaged 8.76 grams of fresh weight and 1.5 grams of dry matter, while those produced without the extra light weighed an average of 7.4 grams and contained 1.21 grams of dry matter. Reflected light increased the size and dry matter production approximately 20 per cent. Unfortunately, the experiment was not designed to measure the influence of reflectors on speed of growth or yield of cuttings.

In Conclusion

These simple experiments should open an inexpensive route to better use of low-angle winter sunshine. Direct readings of 4500 to 5000 foot candles of light were made off these foil reflectors during sunny days in January. Appreciable light was reflected in cloudy weather, especially if the overcast was not dense. Some heat saving should be accomplished where entire north walls or gables are covered with foil. The foil used in this experiment appears quite durable. No noticeable loss of reflectivity occurred in the aluminum during this test. Reliable measurements on small losses of reflective properties are difficult to make unless light and angle of measurement are constant.

It will be interesting to see the ingenious methods of reflection developed by commercial growers in the near future.

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