FIRST Research Report

Light Management in Greenhouses

III. The Effect of Hanging Baskets on the Greenhouse Light Environment

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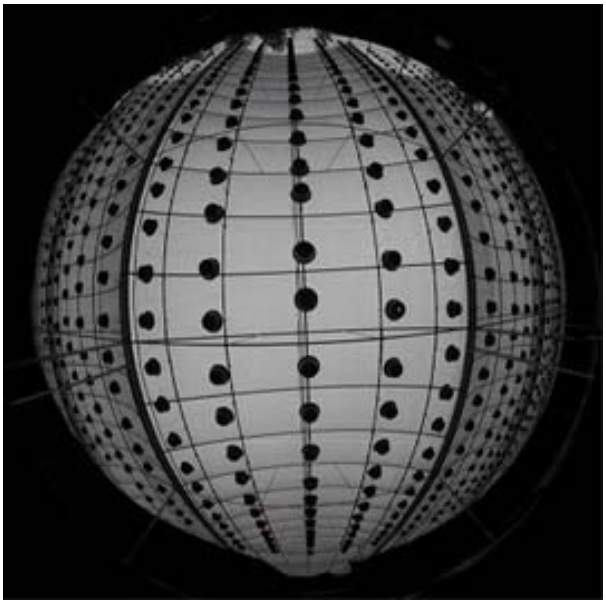
Hanging baskets intercept light that would otherwise be delivered to the bench crop. For example, Figure 1 displays a "plant's eye" view of hanging baskets placed overhead. The hanging baskets in the figure intercepted 10% of the light that would have otherwise reached the bench crop. Too many hanging baskets overhead can obviously reduce plant quality on the bench crops by reducing the daily light integral delivered to those crops.



How many hanging baskets can be grown overhead? This question is usually answered through trial and error based on observations of the bench crop; however, a more precise answer can be estimated based on light measurements with a portable daily light integral (DLI) measuring devise (available from Spectrum Technologies) or by using the maps in Part I of this report combined with a greenhouse light transmission measurement. With the DLI datalogger, one can simply place the sensor on the bench to record the DLI reaching the bench crop. The sensor should

be moved to several different locations for a few days since the shadow pattern can vary from spot to spot.

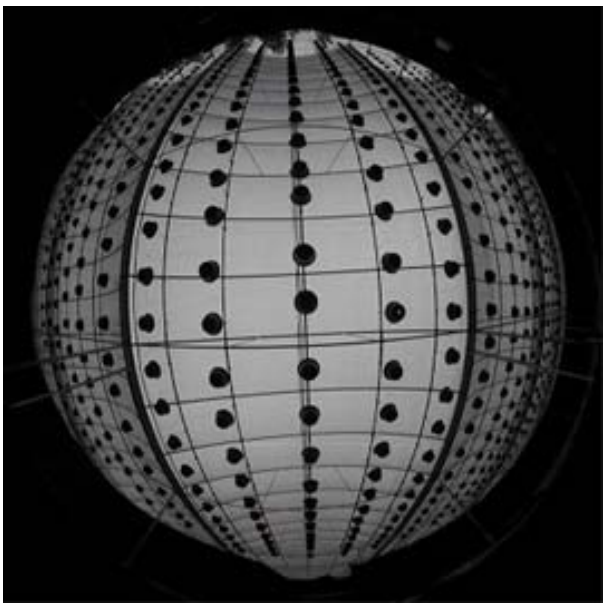
With the DLI maps (Table in Report 1), one can see that Columbus Ohio, for example, the average outdoor DLI for February is 15 to 20 moles/day (we will assume 15 moles/day to account for a below average year). A greenhouse transmission measurement indicates that this particular greenhouse transmits 50% of the outdoor light without any hanging baskets, resulting in 7.5 moles/day delivered to the bench crop during February. If low light crops, like impatiens and begonias, are being grown below the hanging baskets, we can make the assumption 5 moles/day is adequate to grow a commercially acceptable crop. (Note: The baseline daily light integral might be 8 to 10 moles/day for higher light crops, like vinca and marigolds, See Table 1 in Report II for guideline for many crop species). Thus, in February in Columbus, we can place hanging baskets overhead to intercept 33% of the light above the bench, if shade crops are being grown. However, if higher light-requiring crops are being grown, then no hanging baskets can be grown overhead in February. We will have to wait until the daily light integral being delivered to the bench crop exceeds 10 moles/day before considering placing hanging baskets over a high light crop. In this example, this will occur in March.

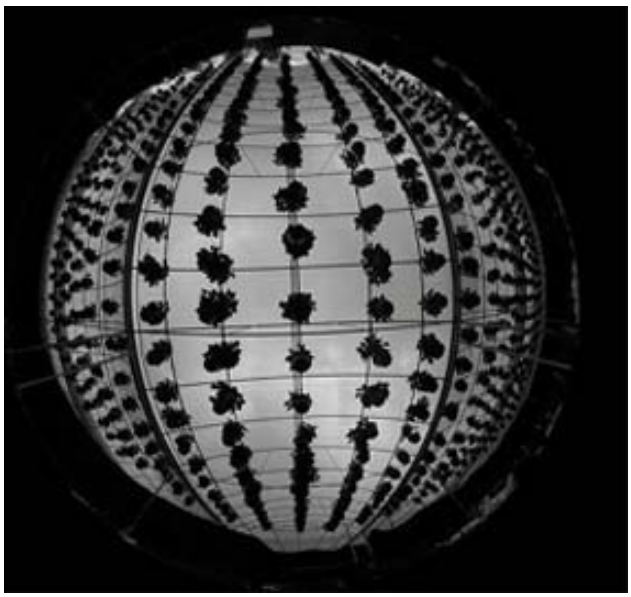
Factors affecting light interception by hanging baskets

Several factors affect how much light hanging baskets intercepts, including plant size, pot color and hanging basket density.

Plant Size. The size of the plant growing in the hanging basket is a very important factor to consider, since a large plant will intercept more light than the basket itself. When hanging baskets are first hung, the plant in the basket is usually smaller than the basket itself. So, the plant doesn't intercept very much light that would otherwise reach the bench crop. However, as the crop grows,

the plant may eventually intercept more light than the containers themselves. Fortunately, hanging baskets are not usually getting large until later in the spring, when the DLI is much higher than in February and March. If the hanging baskets can be marketed at a relatively small size, one can grow a lot more baskets and still allow sufficient light to be delivered to the bench crop. The following photos show green hanging baskets without plants (left) and with plants (right). The density of baskets is 1.5 baskets per m^2 of greenhouse space (10.8 ft^2 per m^2). The empty baskets intercepted 10% of the solar radiation, while the baskets with plants intercepted 27% of the solar radiation.

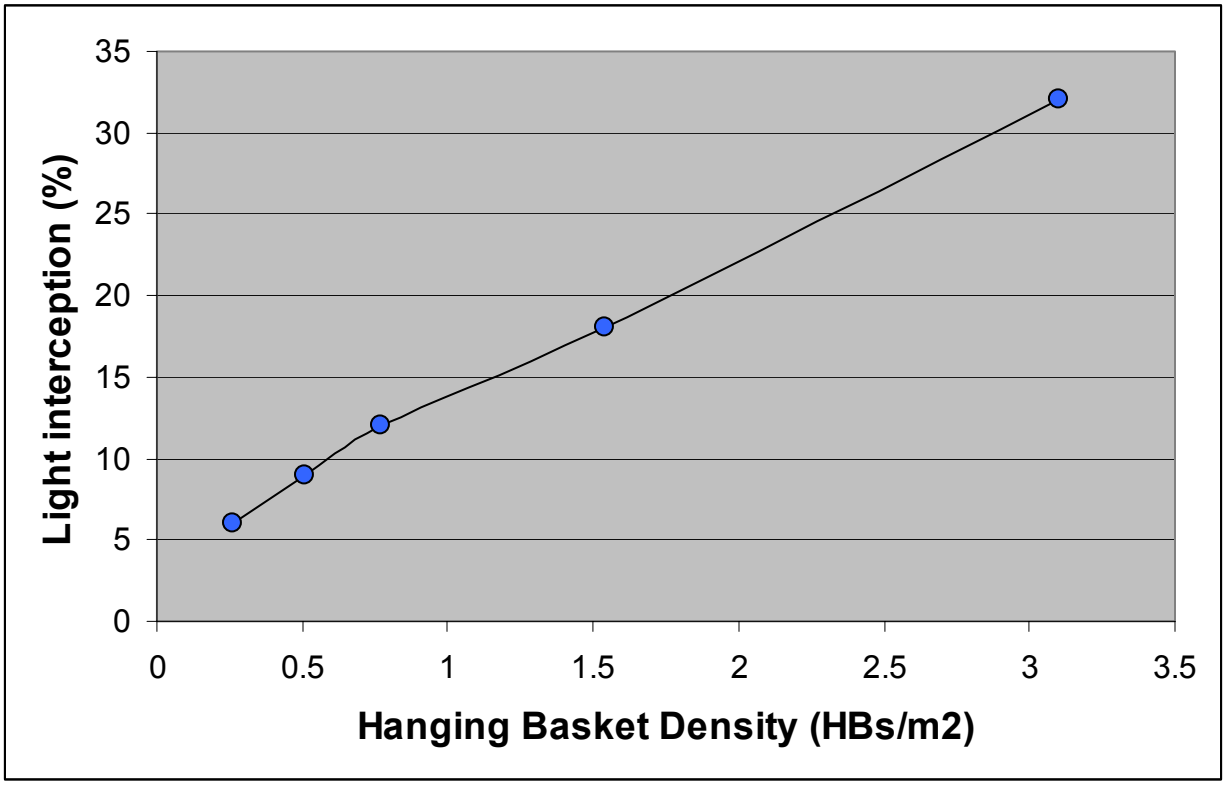




Container Color. The color of the hanging basket container is also important, since green containers can intercept nearly twice the light compared to white containers. The reflective white surface of hanging baskets can significantly increase light transmission of a crop. This is particularly true early in the hanging basket season when the plants are still small. As the plant in the hanging basket grows bigger, less light reflects off the side of the pot, so the effect of container color on light transmission is diminished. Our measurements indicate that white baskets intercept approximately half the light compared to green baskets. For example, if a particular arrangements of green baskets

intercepted 10% of the light, then white baskets would be expected to intercept half that percentage, or 5% of the light.

Hanging Basket Density. Obviously, the more hanging baskets the more light intercepted. We made light measurements under 5 different hanging basket densities. The following graph shows a general response for light interception by green hanging baskets.



Growers can calculate their hanging basket density to estimate the light interception by green hanging baskets. These number reflect the means of treatments with and without plants in the baskets. So, large plants will result in higher interception and smaller plants with less intercept. White containers will also result in less light interception.

Hanging Basket Arrangement. We did not observe any measurable difference in light interception when equal numbers of baskets were hung in one layer versus multiple layers. For

example, we placed 6 lines of baskets in a greenhouse that were all hung at the same height. Then, we placed the same number of baskets on just 3 lines using S-hooks on every other basket to create a two-tier crop. Both arrangements intercepted similar amounts of light.

Hanging Basket Line Orientation. Hanging basket lines can be run north-south or east-west. North-south lines are recommended, because the shadow pattern across the benches is constantly changing which results in a more uniform growing environment. East-west lines create relatively constant shadow patterns, especially from September to April. This results in poor uniformity of light delivered to the bench crops, thus some plants can receive much higher light levels than neighboring crops. Poor light uniformity creates a problem with watering, since light interception and water use are closely correlated.

Red-to-Far-Red Light Ratio. Plants in hanging baskets can reflect or filter sunlight before it reaches the greenhouse floor. Since plants intercept red light quite readily, the light that is reflected or filtered from plants in baskets has less red light than far-red light (sunlight has equal amounts of red and far red light). Low red-to-far-red light ratios promote stem elongation, so it has always been a concern that hanging baskets will cause bench crops to elongate more rapidly. Our data suggest that relatively high hanging basket densities (>1.5 baskets per m^2) will lower the red-to-far-red light ratio slightly. However, the change is relatively small, so we are of the opinion that hanging baskets do not have major impact on light quality (red-to-far-red light ratio), so the major issue with baskets is the effect on light quantity (daily light integral).