By Erik Runkle

The R to FR Ratio

Unlike people, animals and insects, plants are not able to get up and move. They are stuck in the container, or in the landscape, where they are planted. However, plants are able to adapt their growth to try to position stems and leaves so that they receive more desirable light conditions. Plants have different kinds of receptors that perceive light quality, or the colors of light, to which they are exposed. One of these receptors is phytochrome, which is particularly sensitive to the amount of red (R) light relative to the amount of far-red (FR) light.

The ratio of R to FR light (R:FR) influences growth attributes of floriculture crops including branching and elongation of stems and leafs. It also controls flowering in plants that are sensitive to day length. Plants that grow best under high light (full sun) conditions are more responsive to changes in the R:FR than plants that tolerate low light (shade).

Plants are very good filters of light. They absorb and use most of the R light available to them for photosynthesis, but reflect or transmit most of the FR light, since FR light is not useful in photosynthesis. As a result, nearby plants (including those hanging above) reduce the amount of R light more than FR light, thus creating a lower R:FR. The R:FR decreases as the density of the plant canopy increases. This decrease in the R:FR is the signal that plants use to indicate the presence of competing plants.

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How do plants respond to this competition for light? They alter their growth in an attempt to position their leaves so that they can capture more R light. In particular, stems, leaves, and petioles elongate, while lateral branching is inhibited. Leaf size can also increase, so that plants are better able to capture available light. These responses to plant shading are collectively known as the "shade avoidance response." Again, the cue that drives this response is a decrease in the R:FR, not a decrease in light intensity.

In contrast, when full-sun plants are provided with high light conditions and no plant filtering, plants respond to the relatively high R:FR by increasing branching. There is little need for plants to elongate and so instead, they produce more shoots to capture more light. Leaves that develop under high light are relatively small and thick, and growth is more compact.

In the greenhouse, the R:FR is influenced by a number of factors, including:

- Close plant spacing — this is why plants spaced closely together stretch so much
- Hanging baskets — under a very dense canopy of plants, the R:FR can decrease, potentially causing some plants below to elongate
- Artificial lighting — incandescent lamps emit light with a low R:FR, which is why plants become taller under these lamps compared to fluorescent or high-pressure sodium lamps
- Filters — some cladding materials selectively reduce the transmission of FR light, thus creating a higher R:FR and inhibiting plant elongation

As mentioned previously, the R:FR can also influence flowering, especially in long-day plants. Numerous studies have shown that some plants flower earlier when lamps used to provide long-day lighting emit a moderate to low R:FR. When lamps have a high R:FR, such as with fluorescent lamps, flowering of some crops (such as petunia and pansy) can be delayed. Therefore, for these crops, there can be a trade-off between rapid flowering and compact growth. g

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