By Erik Runkle

LEDs in Floriculture

LED technology, first used in the mid-1980s, has come a long way and may make its way into the greenhouse in coming years.

Light-emitting diodes have been around for decades. Sometimes we see them used individually, such as power indicators for stereos or televisions. Other times, dozens of them are clustered together to form an array, such as the red light of traffic signals. In horticulture, LEDs were first used for plant-growth studies in the mid-1980s on the space shuttle and in space stations. At that time, LEDs were only available at a high cost in a relatively dim red. But LEDs have since advanced to the point that we may see them in greenhouses in the next decade.

Potential Benefits

LEDs have several advantages compared with traditional lighting sources. First, most LEDs emit a narrow range of light; only red or only blue, for example. This might seem like a disadvantage at first, but it actually enables the combination of different LEDs into an array to produce a specific light quality. For example, we know that green light is less efficient at eliciting a photosynthetic response compared with red or blue light. Therefore, we could design an array based on plant responses to light. Second, LEDs are much more efficient at converting electricity into photosynthetic light when compared with traditional artificial light sources. One recently published report states that LEDs consumed about one-third the amount of energy as high-pressure sodium (HPS) and metal halide lamps that produced the same light intensity. Because they produce less heat, LED arrays can be placed closer to plants than HPS lamps, which enable a higher light intensity without an excessive increase in plant temperature.

A few other advantages of LED systems: They have a long operating life (at least 50,000 hours), can be easily dimmed if desired and turn on instantly; there is no warm-up period, unlike HPS lamps. Finally, LEDs don't pose as much of a disposal problem as lamps that contain mercury or other heavy metals. With all of these advantages, why don't we see LED arrays used in greenhouses today? Cost.

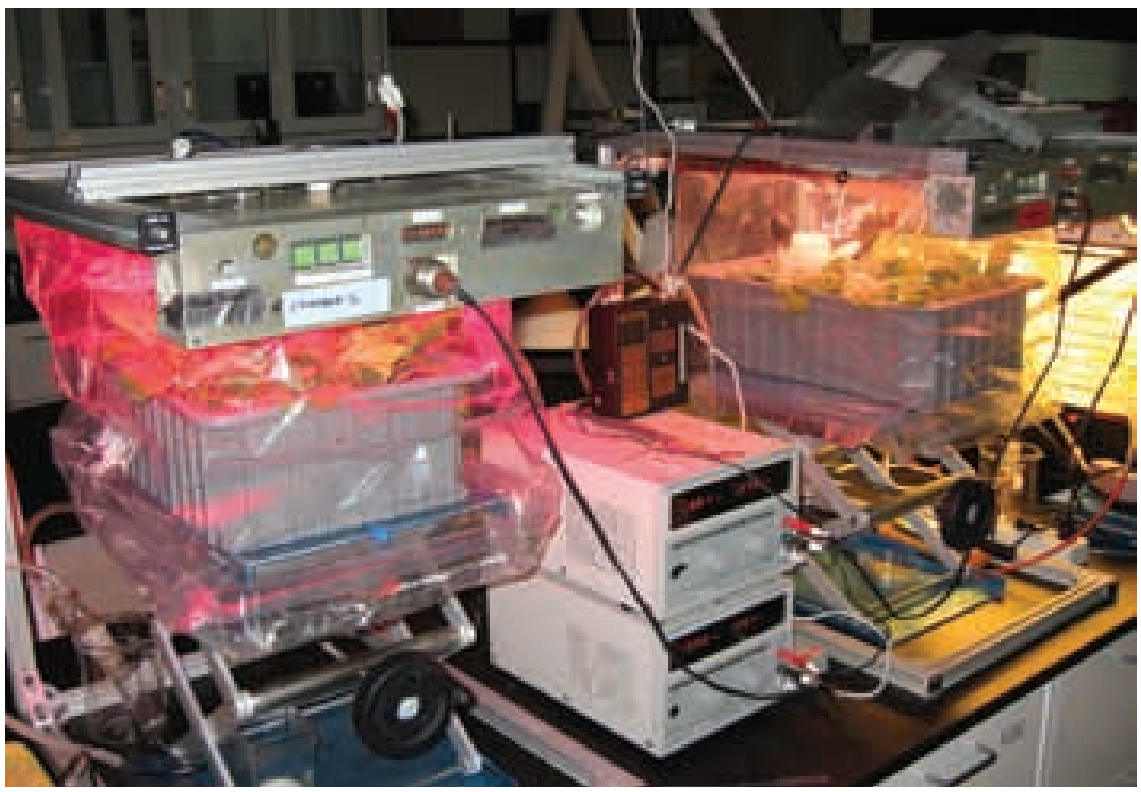

Figure 1. *NASA researchers have been performing plant-growth experiments with LEDs for more than 20 years. As their cost comes down and efficiency goes up, we may see them in greenhouses within the next decade.*

Current Drawbacks

Although the cost of LED arrays continues to decrease, and light intensity for individual diodes increases, they are still cost prohibitive for commercial greenhouse applications. Small LED arrays can already be purchased for home use, but their light output is quite low and, given their cost, aren't economical for low-intensity photoperiodic lighting. However, LEDs are beginning to be used in Japanese commercial plant factories that produce vegetable transplants.

We face a "which came first, the chicken or the egg?" quandary with LEDs: Because there is very little demand for LED arrays for plant growth, they require a lot of labor to manufacture, so cost is very high. Because they are expensive, demand for LEDs is low and restricted to specialized situations, such as research on growing plants in space (Figure 1) or other scientific experiments. With adequate demand, manufacturing can be automated, and in theory, costs can dramatically decrease.

Many plant-growth studies have been performed with LEDs as the sole light source, but few have studied LEDs as sunlight supplements. Research for greenhouse applications is therefore needed to determine desirable LED array spectrums and their impacts on plant growth and plant morphology. GPN

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