Breeding better crops faster with LED lights

Speed Breeding Greenhouse Using a speed growing technique that employs LED lights has the potential to dramatically accelerate the process of breeding better-performing crops, according to researchers at John Innes Centre in England and Australian institutions, the University of Queensland and the University of Sydney. Results of the study appeared in January in the scientific journal Nature Plants. The new speed breeding technique means that it's now possible to grow six generations of wheat every year—a threefold increase over current growth rates.

"Globally, we face a huge challenge in breeding higher-yielding and more resilient crops," says Brande Wulff of the John Innes Centre, lead author on the paper. He explains that plants look green to the human eye because they use the blue and red light in the visible spectrum for photosynthesis and reflect the green light. Sodium vapor lamps that have traditionally been used in greenhouses produce a lot of light in the green and yellow spectrum. "So, although to the human eye, sodium vapor lamps look bright, most of this light is useless to plants," he explains. "The sodium vapor lamps also produce a lot of heat—again not directly useful for photosynthesis," he continues. "We are therefore wasting a lot of precious energy in our glasshouses [greenhouses]. It is more cost-effective to produce light in the photosynthetic active part of the spectrum, and if you need to heat the environment in which you grow the plants, there are often cheaper sources for this than electricity."

Wulff says that the LED lights are the main feature of this approach to speed growing, but the process also uses a slightly more intense fertilizer regime to enhance growth. "We have found that it is essentially a simple technology that has proven itself easy to install and adopt in different labs around the world," he notes. Wulff says that in recent years there has been a revolution in the quality of LED lights and their cost has plummeted, which will help lower the barriers for more widespread adoption of speed breeding for commercial crop production. "I would like to think that 10 years from now you could walk into a field and point to plants whose attributes and traits were developed using this technology," he says.

In addition to wheat, the speed breeding technique has been used for barley, peas, chickpeas, and canola. Speed breeding can be combined with other technologies, including CRISPR gene editing, to provide additional benefits, notes researcher Lee Hickey from the University of Queensland.

Wulff explains that it typically takes 15 to 20 years to breed a superior new crop variety, and the number of generations that can be cycled through in a year is one of the bottlenecks in traditional breeding approaches. In the 1950s and 1960s, an approach called shuttle breeding helped bring about what has been termed the Green Revolution, allowing breeders to grow two generations of wheat in a year. If these researchers have their way, a new Green Revolution may be in the works.

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