DEPARTMENT OF BOTANY

SARAH MORTON — College of Letters & Science

Undergraduate student Emma Keel holds a tray of Arabidopsis thaliana seedlings. Professor Edgar Spalding refers to Arabidopsis as the "fruit fly" or "lab rat" of the plant world because its comparatively small genome and speedy life cycle make it ideal for use in experiments.

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Professor Edgar Spalding works with undergraduate student Emma Keel, right, in his laboratory. Many UW-Madison professors — Spalding included — create opportunities for undergraduate students to participate in research, allowing students to gain valuable hands-on experience in a laboratory, and opportunities to conduct their own research.

Computer data drive study of plant growth, genetics

EDGAR P. SPALDING
Special to the State Journal

There are pencil marks on a wall in our house that record a child's growth. A pencil, a ruler, and some coaxing are all you need to quantify the precious process.

But what if you care about plant growth and the genes that control it? And well you might — if you like to eat, breathe, sleep under a roof, take medicines, or wear Carhartt.

While methods of yore charmingly suit our families' needs, plant growth research needs higher-tech solutions.

Twenty years ago, my laboratory needed a new way to measure the growth of tiny seedlings of the Arabidopsis thaliana plant, a "lab rat" for plant biologists.

We settled on digital image analysis as the technological basis for new methods. We developed computer programs that could automatically measure elongation rate minute by minute from time-lapse images.

Using the new methods, we discovered details about the molecular pathways that seedlings use to sense light that traditional methods had missed. But, more importantly, we discovered that automatic image capture and computational analysis was scaleable.

Creating a high-volume, high-resolution capability expanded the type of scientific question we could investigate.

Instead of comparing one genetic variant to another in order to add an increment of new information, this sophisticated and automated way of working allowed us to measure differences between all individuals in a genetically diverse population.

By analyzing the resulting big data sets with specialized statistical methods, we identified regions of DNA in the genome that controlled the quantified growth process.

We could now map the physical traits of the plant to their genetic underpinnings, and with the bonus of treating those physical characteristics as a time course instead of an end-point trait like height.

Adding "time's arrow" to the measurement of those physical characteristics has proven useful in our efforts to determine the function of genes controlling plant growth and development, and is one of our specialties.

Being able to treat an attribute of the plant as a living process instead of a static trait is a dividend of the automation we have achieved at all stages in the pipeline – from image capture, to analysis on UW's high-volume computing resources, to the statistical modeling that hopefully generates new understanding.

In recent years, we have applied this new way of measuring growth to the study of gene function in maize seeds and seedlings. The goals are relevant to plant breeding and crop improvement.

With more than 100 billion corn kernels germinating each spring across four million acres in Wisconsin, a small improvement in seedling performance could go a long way.

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ABOUT THE SCHOLAR

Edgar Spalding is a professor of botany. He studies the biology of seedling growth and development. His lab develops tools required to make automated, image-based studies of growth and development possible. Measuring with these sophisticated tools is key to understanding the genetic resources at work in plant growth.