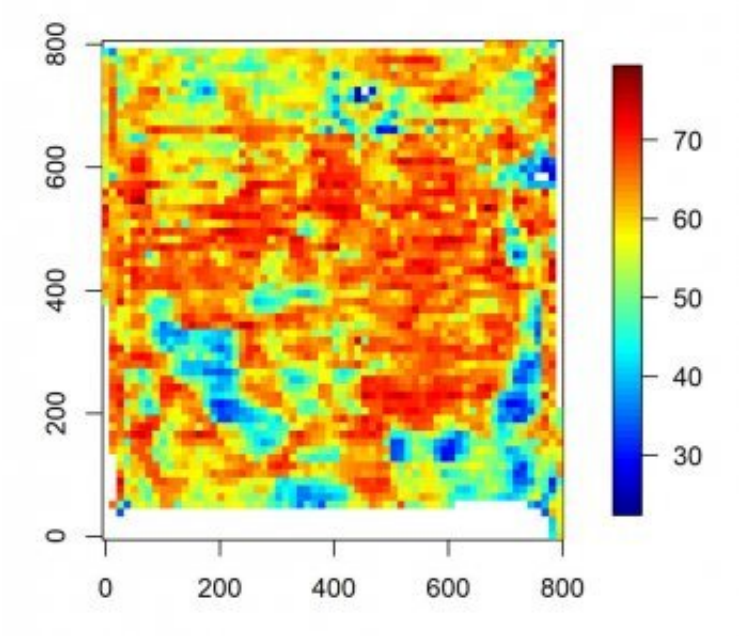
Statistician assesses agricultural data to increase productivity

November 25 2020, by Christie Delfanian



This map shows soybean yields ranging from 70 to 30 bushels per acre (bar on right) across an 800- by 800-meter, or approximately 160-acre, field. This yield data helps researchers analyze data on the effectiveness of two fungicides in treating white mold. Credit: South Dakota State University

Assistant professor Hossein Moradi of SDSU's Department of Mathematics and Statistics is helping precision agriculture faculty efficiently and accurately assess variables affecting yield. This collaboration is helping researchers pinpoint ways to help farmers increase productivity.

"Remote and onsite sensing technologies, such as satellite imagery and yield monitors, generate a wealth of data even for a single field," said Moradi, who specializes in high-dimensional datasets correlated over space and time. That data can be used to assess the affect variables, such as soil chemistry, topography, application of fungicides, herbicides and fertilizers, have on crop yield.

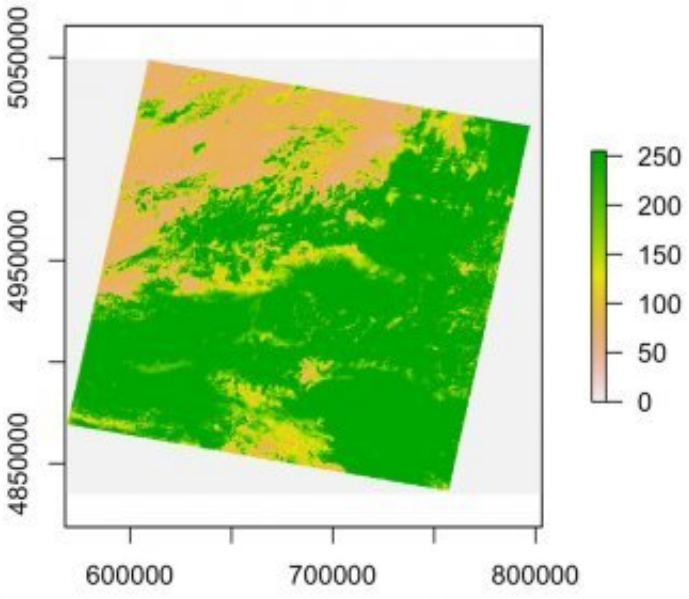
"By estimating the effect of the variables, we can help farmers make more informed management decisions," Moradi explained.

Professor David Wright, head of the Department of Agronomy, Horticulture and Plant Science, said, "Our collaboration with Dr. Moradi and other statisticians' results in more expedient processing of large amounts of data and helps us train individuals to interpret data from digital agriculture."

The research is supported by the Department of Agronomy, Horticulture and Plant Science and U.S. Department of Agriculture Hatch Act funding through the South Dakota Agricultural Experiment Station.

Evaluating effectiveness of fungicides

Moradi and doctoral student Paul May developed an efficient means of analyzing data from a white mold study involving two fungicides. "Our job was to determine the impact of each fungicide and if that impact is statistically significant or not," Moradi explained. To do this, the researchers developed a model that "uses indicator variables for places where each fungicide was and was not applied."



This Landsat 7 image shows the reflectance values in the bar, on the right, from one of the eight spectral bands which is being used to help predict corn yield in a specific field. The field's coordinates are on the x and y axes. Credit: South Dakota State University

The commonly used method, known as ordinary least square, requires a minimal amount of processing time, but it has a high margin of error. However, a more accurate method, the maximum likelihood estimate approach, uses 50,000 data points and requires 60 to 70 gigabytes of RAM and two hours of high-performance computing time. "Farmers do not have access to this type of computing power," Moradi noted.

"Our method takes only 10 to 15 minutes of computing time and the margin of error is nearly the same as the MLE approach," Moradi said. In addition, the analysis requires less than 2 gigabytes of RAM so the program can be run on a workstation or laptop computer.

Predicting corn yield

For another project, Moradi and master's student Shahrukh Khan are using satellite images from Landsat 7 to predict corn yield on a specific farm.

To do this, they developed a deep-learning model that selects features from the Landsat data and combines them with 13 other indices as well as climate data to predict crop yield. "Thus far, we have enough evidence that our model outperforms some other traditional approaches," Moradi explained.

His long-term goal is to launch a website that allows farmers to have a fast, accurate prediction of their expected crop yield using the field locations/coordinates and the last five years of crop yield data. The built-in statistical programming package in the website would then pull historical information about weather, precipitation and temperature and combine that with satellite images, such as those from Landsat, as well as the fields' soil characteristics.

The output would "tell the farmer couple of months in advance to expect this much product out of the field," he said.

Provided by South Dakota State University