Image-based seed phenotyping analysis in maize

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Maize is the third most important cereal grain in the world and has wide range of uses such as food, energy, industrial materials, and pharmaceutical materials. However, the utilization of maize in terms of food crop development and industry requires a new breeding selection method. For this reason, we tried to measure agricultural characteristics of maize lines using the recently developed phenomics technology. In this study, ImageJ and macro programs were applied to analyze the morphological traits and color of 29,450 maize seeds from a population of 298 lines including field corn, popcorn, waxy corn, and recombinant inbred lines (RILs). From each seed image of maize lines, the image parameters of the area, perimeter, width, circularity, roundness, solidity etc., were measured. Correlations between image data and actual measurement data of maize seeds showed high values of 0.97 or more, thereby showing the accuracy of image data. A visualization program of seed color was developed to analyze in detail the characteristics of each line of maize. This program is designed to extract the representative color and color table for hex code values from RGB image for each individual seed. More than 100 seeds can be placed and analyzed at once using this program. The maize population was divided into 10 groups by hierarchical cluster analysis with representative colors. The digital image-based seed phenotyping analysis methods used in the current study will provide basic information for maize breeding with high accuracy reliably.