

Sunflower dimensions - Are two manual measurements sufficient?

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Sunflower head dimensions can be correlated to pollinator attraction and seed yields. In general, measurements are done manually using a thread and ruler or micrometer, which can be subjective and tedious (Fig. 1-left). In addition, this manual method limits the number of measurements to only a few, for example, two: one horizontal and one vertical dimension for each sunflower head and disc measured. It will be intriguing to know whether these two measurements statistically represent a sufficient number, and accurately depict the floral dimensions.

An image processing method will be a better alternative as it can be developed to make multiple radial measurements and will be objective and rapid. Also, the dimensions of individual components (e.g., head, disc, petals.) can be measured in a single computation.

Hence, specific objectives of this research were to (i) develop an image processing method for measuring multiple radial measurements of sunflower head, disc, and petals, and (ii) determine the effective number of measurements that best represent the dimensions of each component.

A digital SLR camera was used to capture images in the field with a white-board as background (Fig. 1-right). The captured image was subjected to a sequence of image processing operations and dimensions are measured using 'pixel-march' technique (pixel by pixel accounting).

Digital measurement from the centroid of the head to the object boundary along the selected direction (angle), was used for performing multiple radial measurements (Fig. 2). The distance between blue points on either side (E and W) will be the head dimension, the distance between green points (E and W) is the disc dimension,



Fig. 1. Manual measurement of sunflower dimensions (left) and digital image acquisition in field (right) for image processing method development.

and the difference between head and disc will be the petals dimension (Fig. 2).

Two measurement methods, namely direct and wrapping-polygon were tested. Wrapping-polygon is a new concept developed using a geometrical enclosure that best wraps the sunflower petals (covering all petal tips). A range of radial measurements (2 through 180) was performed by varying angles and was evaluated statistically. Considering 180 measurements around the centroid (1° angle interval, most accurate) as the control, other measurements were statistically compared against the control. The

effective number of measurements required to best represent the dimensions of sunflower head, disc, and petals was the one beyond which an increased number of measurements was not statistically significant.

Conclusions based on preliminary results indicate that more than 30 radial measurements for head and petals and more than 6 for the disc were necessary, and the two manual measurements generally used for sunflower are not sufficient statistically to represent the dimensional variations.

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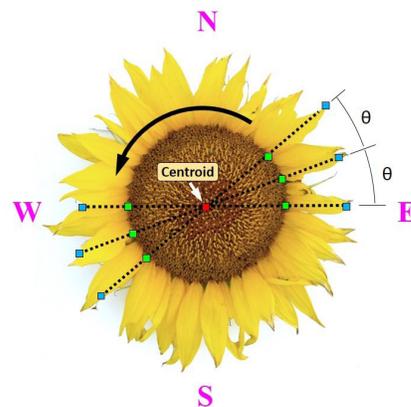


Fig. 2. Multiple radial measurement strategy on a sunflower digital image using the 'pixel-march' technique.