# Seed Morphology

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Seed morphology is the scientific analysis and description of the shape of seeds.

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## 1. Introduction

Traditionally the objective of seed morphology was to provide a concise description, based in qualitative aspects, normally expressed in the form of adjectives.

For example, in the genus *Vitis,* adjectives used to describe seed shape include the following: cordate, globose, globular, oblong, oval, ovoid, pear-shaped (pyriform) rounded, squat and triangular. [1][2][3]

Magnitudes used to measure seed shape in *Vitis* include seed length, seed breadth, chalazal length, chalazal position and others describing primary aspects of the morphology of pips, as indicated by Jaquat and Martinolli[4] and Mangafa and Kotsakis.[3]

### 2. Methods

Modern methods of automated vision are based on the coordinates of the points in a bi-dimensional image and permit new approaches to seed morphology. Digital image analysis coupled with morphometric studies of grape seeds is a relatively new application in the plant research field. By using a set of high-resolution digital images, it is possible to obtain measurements of morphometric, colorimetric and textural features, describing the shape, size, color and texture of seeds, and this quantitative information can be correlated with various qualitative aspects of the seeds. The data obtained, corresponding to magnitudes such as area, perimeter, circularity and roundness [3][5][6][7][8], can be combined and subjected to analysis based on diverse algorithms, for example, elliptic Fourier (EFD) and Aralik descriptors. Finally, in all cases, the data are collected in a matrix and can be submitted to Linear Discriminant Analysis (LDA), to classify the seeds in groups.[9][5][6][10][11][12][13].

There is an interest, both theoretical and applied, in joining both aspects of morphology: the descriptive adjectives and the measurements with the objective of testing if the groups defined by artificial vision and statistical analysis correspond to well defined geometric figures. This objective, that we may define as obtaining new measurable adjectives, can be reached by comparing the seed images with geometric models based on mathematical curves. This way, we obtain the J index that gives the percent of similarity between the two images (the bi-dimensional image of the seed and the geometric model). High values of J index were obtained when comparing images of seeds with the cardioid or modified cardioids in the model plant *Arabidopsis thaliana* (L.) Heynh[14], as well as in the model legumes, *Lotus japonicus* L. and *Medicago truncatula* Gaertn. [15], also in *Capparis spinosa* L.[16], and in species of the Papaveraceae and Malvaceae [17][18].

Other geometric models include the ovoid and the ellipse, that give high values of J index with seeds of species in the Cucurbitaceae[19] and in the Euphorbiaceae, such as *Ricinus* L. and *Jatropha* L. [20][21]. Seed shape in wheat kernels was described based on three geometric figures: (1) an ellipse of aspect ratio (AR) = 1.8 fitting the “round varieties” (T. *aestivum* L. ssp. *aestivum* cv. Zebra and Torka), (2) a lens of AR = 3.2 for the elongated kernels (*T. monococcum* L.), and (3) an ellipse of AR = 2.4 that adjusted well the kernels of intermediate-shaped varieties such as *T. durum* Desf. cv. Floradur [22]. The adjustment of seed shape to geometrical forms has been reported recently in *Vitis* sp. [23]

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