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Corona Shape Variations Among Nine Species of *Hoya*

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Elliptic Fourier (EF) analysis was used to analyze the corona shapes of nine species of *Hoya*. Data were obtained from 239 corona samples. Chain encoded, Elliptic Fourier harmonic functions were generated based on corona boundary. A complexity index of the corona shape was computed using the variation between consecutive EF functions. Principal component analysis was used to select the Fourier coefficients with the best discriminatory power. Differences among the species were summarized in a total of nine independent shape characteristics after principal component analysis of the shape data was done. Higher shape variance (56.13%) is attributed to asymmetries in the shapes of the corona. Cluster analysis based on the shapes of the corona recognized at least three groups of corona shapes. Major differences were attributed to variation in the position of the centroid, the type of floral symmetry, and the direction and shape of the corona hoods. The results of the study clearly showed that Elliptic Fourier shape analysis is an important tool in understanding corona shape diversity in *Hoya*.

Key Words: corona, Elliptic Fourier analysis, *Hoya*, principal component analysis

Abbreviations: EFA – Elliptic Fourier analysis, PCA – principal component analysis

INTRODUCTION

Despite the many species of *Hoya* in cultivation, most of the 51 species native to the Philippines are in the hands of foreign collectors (Siar 2005). The exact identification of these species is not always correct, resulting in disputes over the correct assignment of taxa. Species identification with 100% accuracy is done using the pollinarium of the flowers but this procedure could be very tricky that even noted authorities on *Hoya* admit the difficulty of preparing the pollinarium samples (P.S. – The Hoyan, 2004).

The most conspicuous parts of the *Hoya* plant which are also used for characterizing various plant species are the corona of the flowers. Coronas of *Hoya* are traits argued to be with relatively low dependence on environmental effects especially in the characterization of many samples. However, characterizing corona shapes of the flower is highly qualitative and error-prone. There is a need therefore to explore highly quantitative methods that can be used in determining whether the shape features of the corona could aid in determining shape variations within and among plant species.

The application of reliable objective methods that can detect even very slight differences among species is needed in this genus of plants because of the similarity in the gross morphology of the flowers. These new methods have found wide application in the biological sciences, especially in measurements and in the understanding of biological forms. Such methods are the nontraditional methods of geometric morphometrics.

Biologists use two geometric morphometric methods in studying biological forms: landmark-based and outline-based methods. While there are a lot of controversies as to which method is the "best" for quantifying the morphological difference between forms and for making proper statistical statements about the detected differences, these issues can be addressed based on whether the body form has landmarks or not. In the case of our study of the flower shapes of *Hoya*, we used the method based on the closed outline of coronas of flowers (McLellan and Endler 1998). The single most accessible and useful method is that of elliptic Fourier analysis (EFA), a method supplying the coefficients of a trigonometric function that reproduces as closely as possible a sample curve. As more terms (harmonics) are added to the function, the fit to the sample curve becomes better and better. And as the particular values of the EFA coefficients constrain the function to follow a closed outline, they provide descriptors of the out-