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ANALYSIS OF MORPHOLOGICAL VARIATION OF ANTHURIUM FROM SOUTHERN SRI LANKA

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Abstract

Anthurium andraeanum Linden *ex* André is an important floricultural crop for Sri Lankan export market. There is a high variation in anthurium spathe morphology across Sri Lanka, which has not yet been properly studied for better phenotypes and identification of responsible genetic and environmental factors. This study was carried out for analysis of morphological variation of anthurium grown in southern Sri Lanka. A descriptor for anthurium was developed. Selected morphological characters were recorded from 102 accessions of 25 random growers. Principal component analysis showed that first two principal components (PCs) explained 61% of total observed variation. Spathe length, spathe width, spadix length, and plant height at maturity clustered in PC1, while angle of the spadix, angle between leaf basal lobes and number of suckers were grouped in PC2. Accessions within each cluster derived through the dendogram were of common characters except for spathe colour. Several frequent variants in spathe morphology had been observed.

Anthurium is the largest genus in the family Araceae, consisting of 1000 species (Croat 1992). It is a perennial herbaceous plant with a long-lasting, attractive heart shaped modified leaf named spathe bearing numerous small botanical flowers on a spadix (George 1951). Anthurium flowers are valued for their exotic shape, colorful spathes, and spadices (Chen 2003). Interspecific hybrids contributed a significant increase in anthruium production (Henny 1999, Henny *et al.* 1988, Kamemoto and Kuehnle 1996). Most of the cut-flower anthuriums are hybrids of *Anthurium andraeanum* Linden ex André with several closely related species in the section Calomystrium (Croat and Sheffer 1983), which are referred to as *A. andraeanum* (Kamemoto and Kuehnle 1996).

Variation in anthocyanin concentration results in spathe colour variation (Iwata *et al.* 1985). The white spathes lack anthocyanins and contain colorless flavone C-glycosides (Williams *et al.* 1981)

Moreover, pot plants have become an important commodity in the world market (Ullah 1995). Therefore, anthuriums also have become popular to level of orchids and now being grown commercially for exports as well as for the local markets in Sri Lanka (Dhanasekera 2015). The standard trade types from Sri Lanka in the world market are the "Avo" lines such as Avo Nette, Avo Ingrid, Avo Anneke (Dhanasekera 2015). Anthura lines of Tropical, Midori, Fantasia and Casino anthura are also available. As involvement of females is higher, anthurium industry is important for rural economy (Smeets 2007*)*. The construction of the Hambanthota harbor and the Mattala airport in southern Sri Lanka would increase the potential towards increased production in Matara district: Cut flowers and potted plants can be transported with minimum postharvest losses. In 2014, Sri Lanka earned US$ millions 14.9 worth of foreign exchange through floriculture products indicating an average growth of 5% over the year 2013 where anthurium was a major contributor (Dhanasekera 2015).

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A survey is an efficient tool to explore new cultivars to improve anthurium cultivation: Hawaii scientists had identified *Anthurium antioquiense* Engl. for resistance to bacterial blight through a survey (Kamemoto and Kuehnle 1996*).*

Due to naturally occurring cross pollination and the induced cross pollination by farmers, a number of varieties of anthurium phenotypes are observed in the country. In Sri Lanka, no records are available on precise morphological characterization of anthurium. Therefore, this study aimed at determining the morphological variation of existing accessions in recent potential export area, the Matara district. Such morphological variation would be useful for new cultivar breeding in the future for Sri Lanka.

This study was carried out in the Matara district, Sri Lanka in the agro-ecological zone of WL2, where annual rainfall and temperature are 1900 mm and 28^{o}C, respectively (Department of Agriculture, Sri Lanka). Locations of the Matara district were selected based on the information from the regional divisional secretariat on availability of anthurium growers. GPS points were recorded at each location. Twenty five growers were randomly selected.

A descriptor for 21 morphological characters was developed for 7 quantitative characters of bush height (BH), number of suckers (NS), spathe length (SL), spathe width (SW), spadix length (SPL), angle of the spadix with the spathe (AS) and angle between the lobes at the base (ABL), and 14 qualitative characters of plant group, leaf color at immature stage, nature of the plant, leaf base shape, nature of the leaf basal lobes, overlapping of the two lobes of the leaf base, nature of the leaf petiole, tip of the leaf, color of the veins, spathe color, spathe shape, nature of the spadix, color of the spadix and peduncle color. Accessions at similar growth stage were selected for measurements in 102 plant genotypes. Data were analyzed for principal component analysis and hierarchical cluster analysis through SPSS software (version 20), IBM, USA.

Selected qualitative characters showed a variation: Five spathe shapes, three plant configuration types, three leaf color types, three leaf basal shapes, symmetrical and non-symmetrical leaf basal lobes, overlapped and non-overlapped leaf basal lobes, pointed and blunted leaf tips, three color types of leaf veins were among them. A wider variation was observed in spathe color and spadix color (Fig. 1).

Two PCs explained 61% of total variation. Spathe length, spathe width, spadix length, and bush height at maturity were clustered in PC1, while angle of the spadix, angle between leaf basal lobes and number of suckers were grouped in PC2. According to the hierarchical cluster analysis, 10 clusters formed at a rescaled distance of 5 (Fig. 2). Corresponding qualitative characters coincided with each cluster of quantitative characters except for the spathe color. As the quantitative characters are mostly environment independent, above coincidence may indicate the possible genetic variation within clusters (Fig. 1).

The location of anthocyanin accumulation in spathes differed among *Anthurium* species (Wannakrairoj *et al.* 1990). In addition, Umaharan *et al.* (2010) have investigated the relationship between epidermal vacuolar pH and a number of plant factors, including cultivar, spathe color, developmental stage of the spathe and location of anthocyanin in spathe. Variation observed in flower color in our study may relate to above situation. Further evaluation of the germplasm at molecular level would provide more precise information for genetic diversity for flower color and spathe morphology.

Occurrence of spathe variants of one small sub spathe or several right upon the main spathe was observed (Fig. 3).

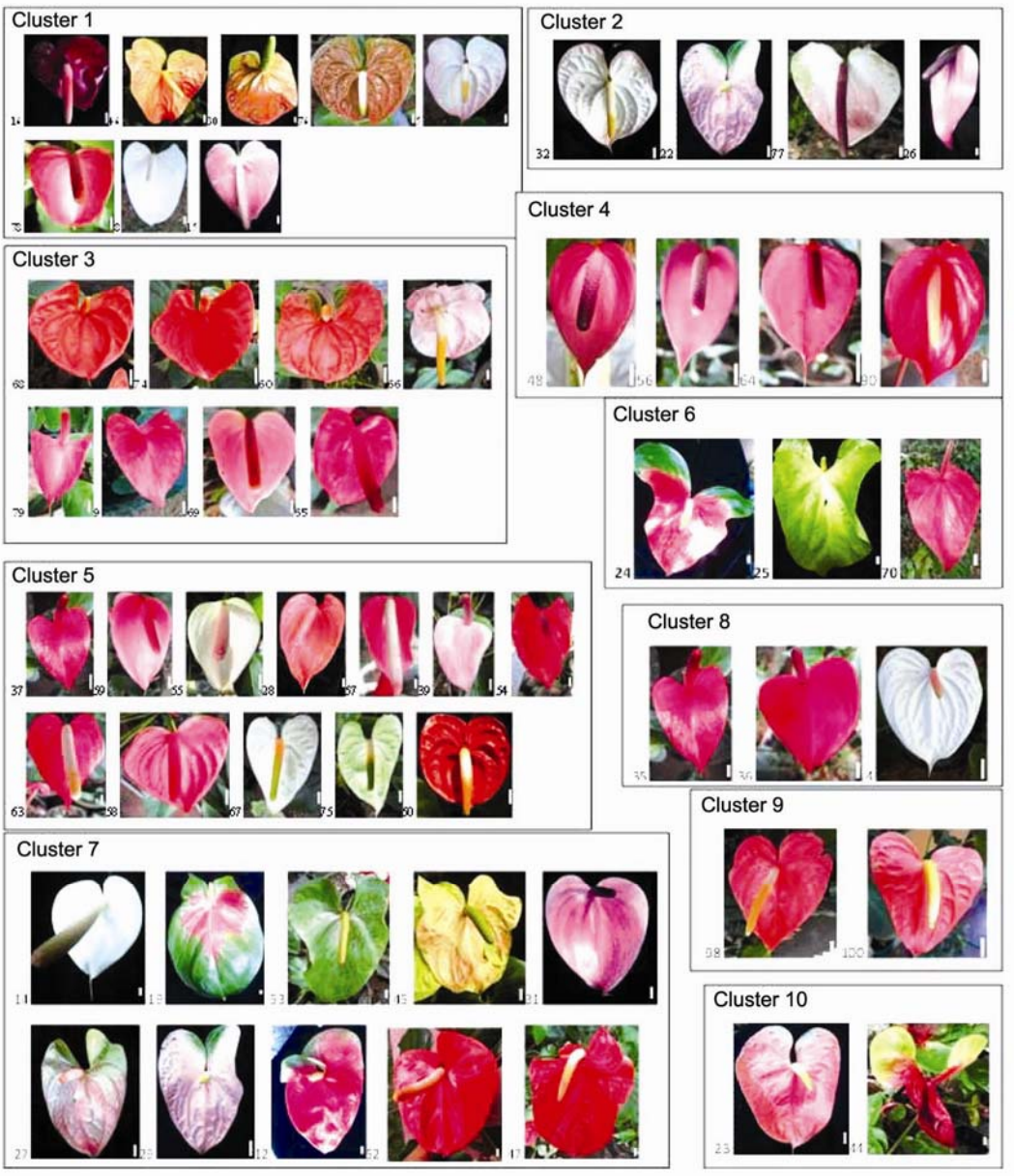

Fig. 1. The representative *Anthurium andraeanum* accessions from each cluster of dendogram. The bar indicates 1 cm.

Accession number 47 of abnormal spathe and mother accession number 52 clustered in the same cluster seven, while accession 66 of abnormal spathe was in cluster three and mother accession 32 was in cluster two (Fig. 1). In variant accession 66, the spathe has become smaller. In variant accession 47, spathe has become larger, in contrast to its mother accession while plant height has reduced. Variant "a" was unique in the collection (Fig. 3).

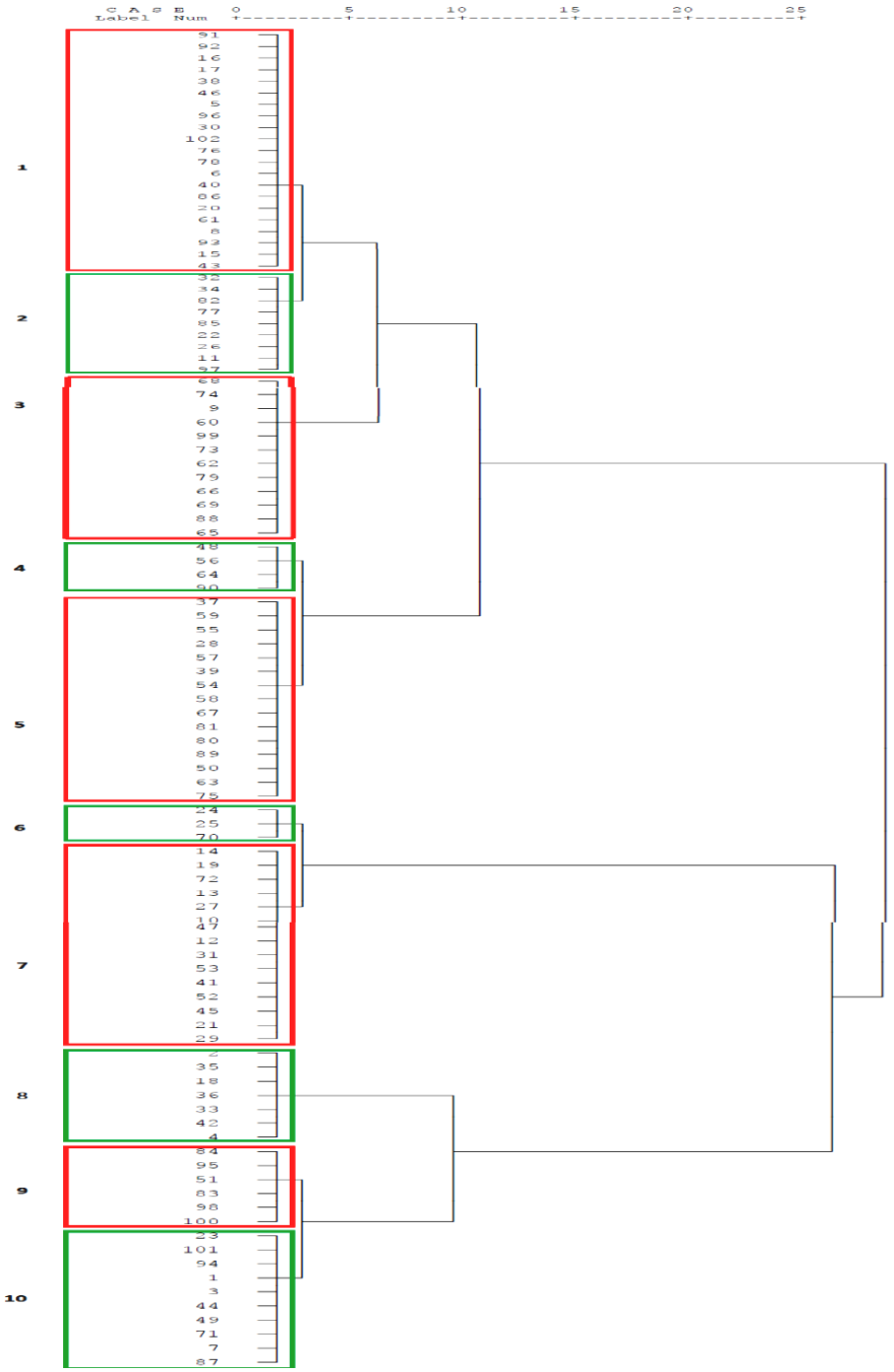

Fig. 2. Dendogram of accessions from Matara district derived through Ward's linkage cluster analysis.

Fig. 3. Naturally occurring spathe variants. Accession 47 and 66-Frequently observed spathe variants: a-The very uniquely observed spathe variant: 32 and 52-Mother genotypes of the variants 66 and 47 respectively.

Several *in vitro* mutation breeding attempts have been recorded for spathe morphology (Puchoo 2005). According to our survey on anthurium market potential, growers receive a low market value for existing cultivars. In above scenario, natural variants of anthurium spathe would be of importance.

In conclusion, there is a high morphological variation in anthurium accessions grown in Matara district. Naturally occurring spathe variants are available in the germplasm.

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