Proc. Fla. State Hort. Soc. 131:49–51. 2018.

Morphological Characterization of Inflorescences and Flowers of 200 Mango Varieties (*Mangifera indica L.*)

Noris Ledesma*[1], Felipe Segundo Varela[2], Francisco David Algarin[2], and Richard J. Campbell[3]

[1]*Fairchild Tropical Botanic Garden, 10901 Old Cutler Rd, Coral Gables, FL 33156*

[2]*University of Magdalena, Santa Marta, Colombia*

[3]*Ciruli Brothers, LLC, 856 W Sahuarita Rd., Sahuarita, AZ 85629*

Additional index words. *Mangifera indica,* morphology, inflorescences, breeding, genetic resources, germplasm

Studies were made on the morphology of the inflorescences and flowers from 200 mango varieties, collected from the mango collection at Fairchild Tropical Botanic Garden, Homestead, Florida. Single trees of each cultivar were characterized following international standards, IPGRI (IPGRI, 1980). Evaluations of flowers and inflorescence morphology were done during the months of January to February. Inflorescences were randomly selected from each tree, photographed for evaluation of flower structure. Morphometric variation in the number, percentage, and ratio between hermaphrodite and male flower among the cultivars was observed. The inflorescence's shape and color also vary between cultivars. In some cultivars, male flowers had a distinctive petal color, while the hermaphrodite flowers did not. This study was based on a single year of data collection and should be considered preliminary in nature. The present investigation will be used as an informational base for future breeding and as a tool for the taxonomic discrimination of varieties of *Mangifera indica.*

Mango (*Mangifera indica* L.) is one of the most popular fruit of the tropics and belongs to the Anacardiaceae family with 60 genera (Galán, 1999). Fundamental understanding of mango flowering is essential to efficiently utilize cropping management systems which could extend both the flowering and crop production seasons. However, the information and appreciation of the floral biology of this popular fruit species is still lacking. Therefore, the objective of this work was to observe the morphology of mango panicles and flowers and to note whether the flowers were male, female or hermaphrodite. In addition, flower shape, structure and color were noted for each type of flower among the cultivars. The objective of the present study was to provide base-line data for future studies in breeding and selecting of mangos.

Materials and Methods

The present experiment was conducted at the Fairchild Tropical Botanic Research Center in Homestead, FL. This farm is located at the geographic coordinates: 25°32'12.91"N and 80°25'55.17" W, classified as a subtropical wet forest according to the life zones of Holdridge. The elevation is 8–14 ft above sea level. The collection is composing of a single tree per cultivar, average of 12 years old, grafted on 'Turpentine' rootstock. Trees have been hand pruned every year after harvest. Fertilization and disease control minimal with low input of chemicals and a reliance on hand labor.

*Corresponding author. Email: nledesma@fairchildgarden.org

Samples. Random samples of five inflorescences per cultivar from a single tree were used for the study. The inflorescences were tagged at the flower bud initiation and observed daily. They were harvested when more than 70% flowers were open. The collection occurred in the morning from 7:00 to 9:00 AM. Additional digital photographs of inflorescences were documented for further analysis according to international standards (IPGRI, 1980).

Evaluations of flower and inflorescence morphology were done in 2018 during the months of January and February.

Results

Morphologic variation in the number, percentage, and ratio between hermaphrodite and male flowers among the cultivars was enumerated. The majority of the cultivars evaluated had between 20% to 50% hermaphrodite flowers. 'Glazier', 'Harris', 'Lembra', 'Momi K' and 'Sardinia' had only male flowers (Table 1).

A small group of the cultivars evaluated had a high percentage of hermaphrodite flowers, with 50% to 70% hermaphrodites in 2018. 'Anderson', 'Angie', 'Diamond', 'Fair Ruby', 'Francis Hargrave', 'Herbie', 'Jewell', 'Julie', 'Langra Benarsi', 'Lippens', 'Long', ' Mallika', 'Mapulehu', 'Number 11', 'Oro', 'Osteen', 'Prieto', 'Reasoner', 'Rosigold', 'Siamese', 'Step', 'Tuehau', and 'Turpentine' all had a high percentage of hermaphrodite flowers in 2018. (Table 1).

The inflorescences shape and color varied among cultivars (Table 2). In some cultivars, male flowers had a distinctive petal color, while the hermaphrodite flowers did not. The present investigation will be used as an informational base for future

Table 1. Morphologic variation in the number, percentage, and ratio between hermaphrodite and male flowers of selected mango cultivars.

Types of flowers	Cultivars
Only male flowers	Glazier, Harris, Lembra, Momi K, Sardinia
Cultivars with < 20% of hermaphrodite flowers	Becky, Cogshall, DIS, Harris, Mabrouka, Momi K, Tahar, Vallenato
Cultivars with 20 to 50% hermaphrodite flowers	Ah Ping, Alphonso, Ameeri, Amrapali, Aslul Mukarar, Ataulfo, Azucar, Banilejo, Baptiste, BD 1-5, BD 3-80, BD 19-21, BD 20-1, BD 34-80, Becky FF, Bombay, Braham Kai Meu, Burgner, Butterfly Hainan, Cac, Cairo, Carrie, Chandrankaran, Chaosavoy, Cobiella, Combodiana, Cowasji Patel, Cushman, CV-21, Diab, Dupuis, East India, Edge Hill, Edward, Emerald, Esmeralda, Eulogio, Ewais, Extrema, Fernandin, Florigon, G-32, Gaylour, Gedong Ginco, Golden Lippens, Golden Nuggets, Golek, Graham, Haden, Herman, Himsagar, Imam Pasand, India, Iris, Ivory, Jakarta, Joe Long, Joellen, Kaeo Luemkon, Karen Michele, Karutha Kolomban, Keitt, Kent, Kesar, , Kim, Lancetilla, Lathrop, Lembra, Lemon Zest, Leshem, Lily, Lucille, *M. lalijwa*, Madame Francis, Magshamim, Maha Chanok, Mahdhimar, Miklet, Mamita, Manga Blanca, Manilita, Manzanillo, Maya, Mesk, Mulgoba, Mumbai, Myatrynat, Nam doc mai, Neldika, Nelpetite, Okrong Tong, Ono, Palmer, Pam Kai Mia, Parvin, Pascual, Peach, Phimsen Mun, Piña Colada, Poh Gedong, Pohn sawadee, Prince, Princess, Pu Pyu kalay, Rapoza, Ratna, Red Pirie, Rosa, Rumanii, ST Maui, Saigon, San Felipe, Sensation, Sindhu, Smith, Sonpari, Sunrise, Sunset, Swethinha, Thai everbearing, Tommy Atkins, Valcarrie, Van Dyke, Van Raj, Wally, Webber, White Pirie, Winters
Cultivars with 50 to 70% hermaphrodite flowers	Ambika, BD 34-89, Bullock's Heart, Chené, Diplomatico, EdXEarle 15, Espada, Fairchild, Fukuda, Glenn, Hodson, Honey Gold, Jean Ellen, Jumbo Kesar, Ott, Panchadarakalasa, Parris, Pickering, Pince, Piva, Pruter, R2E2, Royal Special, Ruby, Shamsul Asamar, Sprinfels, Tong Dam, Totaturi, Tyler Premier, Young, Zebda, Zillate
Cultivars with ≥ 70% hermaphrodites	Anderson, Angie, Diamond, Ruby, Francis Hargrave, Herbie, Jewell, Julie, Langra Benarsi, Lippens, Long, *M. casturi*, *M. odorata* , *M.* sp 'Rampagni', *M. rubropetala*, Mallika, Mapulehu, Number 11, Oro, Osteen, Prieto, Reasoner, Rosigold, Siamesse, Step, Tuehau, Turpentine

Table 2. Morphological variation in mango flowers of selected cultivars.

Characteristic	Cultivars
Yellow male flower with white tones. Cream hermaphrodite flowers with light violet tones	Amrapali, Anderson, Diamond, Fernandin, G-32, Glenn, Golden Lippens, Haden, Hodson, Karen Michele, Kesar, Lippens, M. lalijwa, Madame Francis, Mamita, Pram Kai Mia, Peach, Pickering, Piva, Poh Gedong, Rapoza, Rosigold, San Felipe, Sindhu, Smith, Step, Tahar, Totapuri
Yellow male flower with white. Dark violet hermaphrodite flowers with brown tones	East India, Diamond, Ruby, Iris, Lancetilla, Lily, Mapulehu, Nelpetite, Royal special, ST Maui
Yellow male flower. White hermaphrodite flowers with brown tones	BD 3-80, Florgon, Kent, Lathrop, Mahdhimar, Mallika, Piña Colada, Webber, Winters, Zebda
Violet Male flowers with brown spots. Yellow with white hermaphrodite flowers	Becky FF
Yellow with white male flower. Dark pink hermaphrodite flowers with brown spots	Diplomático, Joe Long, Pu Pyu Kalay.
Yellow male flower with white. Light pink hermaphrodite flowers with light brown spots	Eulogio, Honey Gold
Violet male flowers with brown spots. Yellow hermaphrodite flowers with white	Oro, Pascual

breeding and as a tool for the taxonomic discrimination among varieties of *Mangifera indica*. Digital photographs of flowers were documented and archived for further analysis. The main variation among cultivars are summarized in Table 2.

Most of the cultivars had 5 petals. 'BD 20-1', 'Mabrouka', 'Pohn sawadee, 'Winters' had just 4 petals. 'Alphonso', 'BD 1-5', 'BD 3-80', 'BD 19-21', 'BD 34-80', 'Combodiana', 'Fernandin', 'G-32', 'Haden', 'Joe Long', 'Lemon Zest', *M. casturi*, 'Magshamim', 'Mamita', 'Ono', 'Peach', 'Poh Gedong', 'Pu Pyu kalay', 'San Felipe' had varying numbers of petals (Table 3) in 2018. The average number of stamens was three (Table 3), but variation among cultivars was high.

Discussion

There is considerable variation in inflorescence data for mango from this study. Several of the cultivars that had no hermaphrodite flowers in 2018 are consistent and fair bearing cultivars while several of the cultivars with a high percentage of hermaphroditic flowers are notoriously shy bearers. Therefore, male and hermaphroditic flower percentages cannot be the only factor that determines fruit set and crop load potential. However, these data are important to document the tendency or at least potential of certain cultivars to produce an abundance or a scarcity of hermaphroditic flowers. The variation in floral percentages from year

Table 3. Number of flower petals and stamens of selected mango cultivars.

Characteristic	Cultivars
Cultivars with 4 petals	BD 20-1, Mabrouka, Pohn Sawadee, Winters
Cultivars with 5 petals	Ah Ping, Ambika, Ameeri, Amrapali, Anderson, Angie, Aslul Mukarar, Ataulfo, Azucar, Banilejo, Baptiste, BD-3489, Becky, Becky FF, Bombay, Braham Kai Meu, Bullock's heart, Burgner, Butterfly Hainan, Cac, Cairo, Carrie, Chandrakaran, Chaosavoy, Chené, Cobiella, Cogshall, Cowasji Patel, Cushman, CV-21, Diab, Diamond, Diplomatico, DIS, Dupuis, East India, Edge Hill, Edward, EdXEarle, Emerald, Esmeralda, Espada, Eulogio, Ewais, Extrema, Fair Diamond, Fair Ruby, Fairchild, Florigon, Francis Hargrave, Fukuda, Gaylour, Gedong Ginco, Glazier, Gleen, Golden Lippens, Golden Nuggets, Golek, Graham, Harris, Herbie, Herman, Himsagar, Hodson, Honey Gold, Imam Pasand, India, Iris, Ivory, Jakarta, Jean Ellen, Jewell, Joellen, Julie, Jumbo Kesar, Kaeo Luemkon, Karen Michele, Karutha Kolomban, Keitt, Kent, Kesar, Kim, Lancetilla, Langra bernasi, Lathrop, Lembra, Leshem, Lily, Lippens, Long, Lucille, *M. lalijwa*, *M. odorata*, *M.* sp. 'Rampagni', *M. rubropetala*, Madame Francis, Maha Chanok, Mahdhimar, Maklet, Mallika, Manga Blanca, Manilita, Manzanillo, Mapulehu, Maya, Mesk, Momi K, Mulgoba, Mumbai, Myatrynat, Nam Doc Mai, Neldika, Nelpetite, Number 11, Okrong Tong, Oro, Osteen, Ott, Palmer, Pam Kai Mia, Panchadarakalasa, Parris, Parvin, Pascual, Phimsen Mun, Pickering, Pince-P, Piña Colada, Piva, Prieto, Prince, Princess, Pruter, R2E2, Rapoza, Ratna, Reasoner, Red Pirie, Rosa, Rosigold, Royal special, Ruby, Rumanii, ST Maui, Saigon, Sardinia, Sensation, Shamsul Asamar, Siamesse, Sindhu, Smith, Sonpari, Sprinfels, Step, Sunrise, Sunset, Swethinha, Tahar, Thai Everbearing, Tommy Atkins, Tong dam, Totaturi, Tuehau, Turpentine, Tyler Premier, Valcarrie, Vallenato, Van Dyke, Van Raj, Wally, Webber, White pirie, Young, Zebda, Zillate
Cultivars with 4 and 5 petals	Alphonso, BD 1-5, BD 3-80, BD 19-21, BD 34-80, Combodiana, Fernandini, G-32, Haden, Joe Long, Lemon Zest, *M. casturi*, Magshamim, Mamita, Ono, Peach, Poh Gedong, Pu Pyu Kalay, San Felipe
Cultivars ≤ 3 staminoids	Ah ping, Ambika, Baptiste, BD 1-5, BD-3489, Bullock's heart, Burgner, Cobiella, Diamond, Diplomatico, DIS, Dupuis, Edward, Esmeralda, Espada, Extrema, Fernandini, Francis Hargrave, G-32, Gedong Ginco, Gleen, Golden Nuggets, Herbie, Herman, Honey Gold, Imam Pasand, Jean Ellen, Joe Long, Keitt, Langra bernasi, Lemon Zest, Leshem, Lucille, *M. casturi*, *M. lalijwa*, Maha Chanok, Mallika, Manzanillo, Mapulehu, Neldika, Osteen, Ott, Parris, Peach, Poh Gedong, Pohn Sawadee, Prieto, Princess, R2E2, Rosigold, Sensation, Siamese, Sprinfels, Sunrise, Thai everbearing, Totaturi, Tuehau, Tyler Premier, White Pirie, Zillate
Cultivars ≥ 3 staminoids	Anderson, Angie, Ataulfo, BD 3-80, BD 19-21, BD 20-1, BD 34-80, Becky, Carrie, Cogshall, Cushman, CV-21, Diab, EdXEarle, Fair Ruby, Fairchild, Graham, Haden, Hodson, India, Jewell, Julie, Kent, Lippens, Long, *M. odorata*, *M.* sp. 'Rampagni', *M. rubropetala*, Madame Francis, Maya, Mulgoba, Nam Doc Mai, Nelpetite, Number 11, Oro, Palmer, Panchadarakalasa, Parvin, Pickering, Piva, Rapoza, Royal Special, Ruby, Rumanii, Step, Tong Dam, Turpentine, Van Dyke, Wally, Zebda

to year is most likely under genetic and environmental control.

Most mango cultivars will flower multiple times each year under the proper environmental cues. In these cases, the percentages of male and hermaphroditic flowers are known to vary as well. There is further evidence that the floral percentage will vary across growing regions, ostensibly due to environmental differences among regions. Observations on mango cultivars across regions suggest that the floral percentages are highly dependent on growing location.

This study was conducted in the winter of 2018. The authors are fully aware of the variability inherent in flower data for mango cultivars. Experience and circumstantial data have been the basis of the majority of breeding and improvement programs world-wide with mango. The current study is but the beginning of base-line data for mango that will allow for better decision making in future research into the improvement of the mango.

Literature Citied

Campbell, R., N. Ledesma and C. Campbell. 2001. Tropical Mangos: How to grow the world's most delicious fruit. 71 p.

Galán Sauco, V. 1999. El cultivo del mango. Madrid, ES. Mundi Prensa. 298 p.

IPGRI (International Plant Genetic Resources, IT). 2006. Descriptors for mango (*Mangifera indica* L). Roma, IT. IPGRI. 60 p.

Ledesma, N., 2018. The genetic diversity of mangoes, Burleigh Dodds Science Publishing, Sawston, UK.