

Comparative Study of Flower Sex Ratio in Different Cultivars of Mango (*Mangifera indica* L.)

MUHAMMAD ASIF†, MUHAMMAD USMAN, MUHAMMAD JAFAR JASKANI AND MUHAMMAD MUMTAZ KHAN
Department of Horticulture, University of Agriculture, Faisalabad-38040, Pakistan

†Corresponding author E-mail: roymasif@yahoo.com; Phone: 9200161-70 Ext. 388

ABSTRACT

Three commercial cultivars of mango i.e. 'Anwar Rataul', 'Dasehari' and 'Langra' were studied for panicle initiation time, total number of flowers and proportion of male to hermaphrodite flowers. Early panicle initiation was observed in 'dasehari' on eastern side of the plant followed by 'Langra' and 'Anwar Rataul'. Langra depicted highest number of flowers (598.75) with maximum hermaphrodite flowers (473.08; 79%) on west and southern side of the plant, respectively. The least male flowers (125.75) were also found in 'Langra'. 'Anwar Rataul' depicted minimum number (59.83; 7.25%) of hermaphrodite flowers. Proportion of hermaphrodite flowers in all the three cultivars was quite variable regarding plant side. Such studies in commercial cultivars of mango will certainly be helpful in understanding its floral biology to improve the fruit plant yield.

Key Words: Mango; *Mangifera indica*; Sex ratio; Flowers; Anacardiaceae

INTRODUCTION

Mango is called as king of the fruits (Purse-glove, 1972). Its cultivation is as old as Indian civilisation i.e., four to six thousand years (Mukherjee, 1953a; Kostermans & Bompard, 1993). Its development and culture in the sub-continent was primarily contributed by the Mughal Emperors, particularly Akbar who planted Lakh Bagh, amateur gardeners, nurserymen and farmers by selection and subsequent cloning. Now it has become an integral part of our history and culture. At present, 23455 million tons of mangoes are produced pre year and 509.8 thousand tons being exported in the world. Pakistan holds 5th place contributing 916.4 million tons only 3.9% in the total production of world's mango. India is the largest producer (12000 million tons) followed by China (2142 million tons) and Mexico. While Mexico is the largest exporter (209.4 thousand tons) followed by India and Phillipine. Total mango export from Pakistan is only 40.2 thousand tons of worth 6 M US \$ annually. Main importers are Dubai, U.K. and Saudi Arabia. Facilitating growers and providing incentives can boost up the exports. (FAO, 2000).

Developing comprehension of the mango floral biology is essential as number of perfect flowers is highly relevant to production. The initial fruit set is directly related to the proportion of perfect flowers though the final fruit set doesn't depend on it (Iyer *et al.*, 1989). Proportion of perfect to the staminate flowers (sex ratio) is a variable component within panicles, trees and among cultivars but is usually less than 50%. (Burns & Prayag, 1911; Popenoe, 1917; Maheshwari, 1934; Musahib-ud-Din & Dinsa, 1946; Bajwa *et al.*, 1956; Chacko & Randhawa, 1971; Singh, 1971; El-Nabawy *et al.*, 1983; Gunjate *et al.*, 1983; Pimentel *et al.*, 1984; Chadha & Pal, 1986; Baghel *et al.*, 1988; Hussein *et al.*, 1989 and Joubert *et al.*, 1993). The greatest number of

perfect and staminate flowers are borne in the proximal portions of the panicles (Musahib-ud-Din & Dinsa, 1946; Cobin, 1950). Mukherjee (1953) found that the percentage of perfect flowers in some Indian mango cultivars ranged from 25 to 36.6%. He also noted that higher percentage of perfect flowers in 'Langra' is closely associated to high productivity. Ali (1960) found 78.8% perfect and 21.2% staminate with no pistillate flower in 'Dasehari'. Majumdar and Mukherjee (1961) observed the highest percentage of perfect flowers on northern side of the trees and the lowest on the east side in cv. 'Hemsagar'. Chad (1964) found 1300-1400 flowers from an average sized inflorescence in cvs. Langra, Dasehari and Fajri during "On" year in India. Nakhlla (1980) said that the percentage of perfect flowers varied within the tree and was higher during 'on' years than the "off" years. Desai *et al.* (1985) observed highest percentage of hermaphrodite flowers on the north and least on the eastern side of the mango cvs. 'Alphanso' 'Goamankur' and 'Kesar'. Divergence in the sex ratio seems to be governed by cultivar of physiological and environmental conditions. Mostly, there is greater percentage of perfect flowers found in the distal half of the panicles (Gunjate *et al.*, 1983; Pimentel *et al.*, 1984; Scholefield & Oag, 1984; Hussein *et al.*, 1989). So far, little research has been made on the floral mechanisms of mango in Pakistan. Therefore present research venture was initiated on three commercial mango cultivars i.e. Anwar Rataul, Langra and Dasehari to investigate this very important aspect highly relevant to the fruit production.

MATERIALS AND METHODS

The project was initiated during blooming season at Post-graduate Agriculture Research Station (PARS) University of Agriculture, Faisalabad. Trees were grown

under uniform agronomic and climatic conditions. There were three replications in each cultivar i.e., Anwar Rataul, Dasehari and Langra. A panicle was tagged on each side of plant. Panicle initiation data was noted with the emergence of first panicle on the tree. Male and Hermaphrodite flowers were counted on panicles tagged twice a week throughout the flowering season with forceps and contact lens. Both male and hermaphrodite flowers were detached after counting. Then the percentage of male, hermaphrodite and total number of flowers was calculated. The experiment was laid out in the randomised complete block design (RCBD) and data was analysed by Duncan's Multiple Range test (DMR) at $P > 0.05$.

RESULTS AND DISCUSSION

Panicle initiation date. Among three cultivars, panicle initiation was observed in cv. Dasehari i.e., on February 1st; followed by Langra i.e., on February 7th and lastly in Anwar Rataul i.e., on February 12th. It was also observed that in all cultivars panicles initiation was started from the south side of the plant. This seems to be due to more exposure of south side of the plant to sunlight hence becoming warmer than all other directions. This warmness might be the cause of earliest panicle initiation at the south side in all the cultivars. Our results are not in accordance with the observations of Desai *et al.* (1985) who observed highest percentage of hermaphrodite flowers on the north side and the least on the east side of 'Alphanso' 'Goamankur' and 'Kesar' mangoes cultivars. This difference could be due to cultivar response to the prevailing environment conditions.

Number of male flowers. Statistical analysis showed that cultivars varied significantly ($P > 0.05$) among each other with respect to the number of male flowers (Table I).

Table I. Number of male flowers/panicle

Side	Anwar Rataul	Langra	Dasehari
East	798.6 ab	47.0 c	624 ab
West	633.0 b	215.6 a	1033 a
North	428.0 b	117.6 b	469 c
South	1197.6 a	122.6 b	411 c
Mean	764.3 a	125.7 b	634 a

Different letters in columns are statistically significant ($P > 0.05$)

The cultivar Anwar Rataul had significantly ($P > 0.05$) highest number of male flowers (764.3) but statistically at par with Dasehari while Langra had significantly less number of male flowers (125.7). These results for the cultivar Anwar Rataul are further strengthened by the findings of Burns and Prayag (1911), Popenoe (1917), Maheshwari (1934), Musahib-ud-Din and Dinsa (1946), Bajwa *et al.*, (1956), Singh (1971), Chacko and Randhawa (1971), El-Nabawy *et al.* (1983), Gunjate *et al.* (1983), Pimentel *et al.* (1984), Chadha and Pal (1986), Baghel *et al.* (1988), Hussein *et al.* (1989), and Joubert *et al.* (1993).

Differences in male flower count at the four sides within the cultivars was also found significant in cv. Anwar Rataul and Langra but insignificant in cv. Dasehari. Maximum number of male flowers was observed on panicles of South (1197.6) and West (215.6) sides in cvs. Anwar Rataul and Langra, respectively.

Number of hermaphrodite flowers. Highly significant ($P > 0.05$) difference among three cultivars was observed regarding number of hermaphrodite flowers (Table II). Maximum number of hermaphrodite flowers was noted in Langra (473), which was significantly ($P > 0.05$) greater than Dasehari (168.8) and Anwar Rataul (59.8, Table II). On the other hand, hermaphrodite flower number on different sides of three cultivars was quite variable. In Anwar Rataul, maximum hermaphrodite number was observed on the panicle on the North side (100) while in Langra maximum hermaphrodite number was found on the panicle of the South side. But in Dasehari, maximum hermaphrodite number was noted on panicle of the Eastern side of the plant. Our findings are supported by Majumdar and Mukherjee (1961) and Desai *et al.* (1985) who observed highest percentage of perfect flowers on the north and lowest on the eastern side of the plants of 'Hemsagar', 'Alphanso', 'Goamankur' and 'Kesar' cultivars of mango, respectively. The variability in the flower sex ratio seems to be governed by a cultivar of physiological and environmental conditions.

Table II. Number of hermaphrodite flowers/panicle

Side	Anwar Rataul	Langra	Dasehari
East	42.0 c	429.3 bc	225.3 a
West	36.6 c	543.3 ab	108.0 c
North	100.6 a	337.3 c	195.0 ab
South	60.0 b	591.3 a	147.0 bc
Mean	59.8 c	473.0 a	168.8 b

Total number of flowers per panicles. Data regarding total number of flowers per panicle showed significant difference among cultivars and the sides of the plant. The cv. Anwar Rataul has significantly ($P > 0.05$) greater number of flowers (824.1) but it was statistically at par with Dasehari (803.2) while Langra has significantly less number of total flowers (598.7, Table III). On the other hand, in cv. Anwar Rataul maximum flowers were counted on the panicles of south side (1257.6) while in cvs. Langra and Dasehari total flower number was found highest on the panicles of west side i.e., 750 and 1141.0, respectively.

Table III. Total number of flowers/panicle

Side	Anwar rataul	Langra	Dasehari
East	840.6 ab	476.3 b	849.3 b
West	667.6 b	750.0 a	1141.0 a
North	528.6 b	455.0 b	664.6 c
South	1257.6 a	714.0 a	558.0 c
Mean	824.1 a	598.8 b	803.2 a

Percentage of male and hermaphrodite flowers. Significantly ($P>0.05$) highest number of male flowers (764.33) were observed in cv. Anwar Rataul followed by Dasehari (634.41) while it was significantly lowest (125.75) in cv. Langra (Table IV). Khan and Singh (1946) also reported minimum number of male flowers in Langra. On the other hand, significantly highest number of hermaphrodite flowers (473.08) was observed in the cv. Langra followed by cv. Dasehari. This high percentage of hermaphrodite flowers is found to be closely associated with the more productivity in Langra (Mukherjee, 1953). The cv. Anwar Rataul exhibited lowest number of hermaphrodite flower (59.83). The results of cv. Dasehari are in contrast with the finding of Ali (1960) who observed high number of hermaphrodite flowers in cv. Dasehari. These results are further strengthened by (Burns & Prayag, 1911; Popenoe, 1917; Maheshwari 1934; Musahib-ud-Din & Dinsa, 1946; Bajwa *et al.*, 1956; Singh, 1971; Chacko & Randhawa, 1971; El-Nabawy *et al.*, 1983; Gunjate *et al.*, 1983; Pimentel *et al.*, 1984; Chadha & Pal, 1986; Baghel *et al.*, 1988; Hussein *et al.*, 1989; and Joubert *et al.*, 1993) who observed a variable proportion of hermaphrodite/perfect flowers to the male/staminate flowers (sex ratio) within the panicles, trees and among the cultivars but it was usually less than 50% except cv. Langra (79%).

Table IV. Number of male and hermaphrodite flowers in various mango cultivars

Cultivars	No. of Flowers				
	Male	%age	Hermaphrodite	%age	Total
Anwar Rataul	764.33 a	92.74	59.83 c	7.25	824.16 a
Langra	125.75 c	20.99	473.08 a	79.01	598.83 b
Dasehari	634.41 b	78.98	168.83 b	21.01	803.25 a

Figures showing similar letters in columns are statistically non-significant ($P>0.05$)

CONCLUSION

The results can be concluded as south side of the plants of all the cultivars studied proved to be the earliest for the panicle initiation. This could have happened due to its more exposure to the sunlight. Anwar Rataul and Dasehari showed significantly more number of male flowers than Langra on south and west sides of the plant, respectively. Langra gave maximum number of hermaphrodite flowers on south side while total flower number was less in it. Number of hermaphrodite flowers in all the three cultivars was quite variable regarding side of the plant.

REFERENCES

Ali, K., 1960, Effect of different cultural treatments on the flower sex ratio and production of fruit in mango. *M.Sc. Thesis*, Univ. Agri., Faisalabad-Pakistan.

- Baghel, B.S., D.A. Sarnaik and P.K.R. Nair, 1988. Flowering and fruiting behaviour of different varieties of mango (*Mangifera indica* L.) under Jabalpur conditions. *PKV Res. J.*, 12: 37-9.
- Bajwa, B.S., J.C. Bakshi and T.S. Kocher, 1956. A note of the floral biology of *Mangifera indica* L. var. Dashehri. *Indian J. Hort.*, 13: 206-9.
- Burns, W. and S.M. Prayag, 1921. *The Book of Mango*. Bulletin, 103. Dept. of Agri., Bombay.
- Chacko, E.K. and G.S. Randhawa, 1971. Towards an understanding of the factors affecting flowering in Mango. *Andhra Agri. J.*, 18: 226-36.
- Chad, N.K. 1964. Studies on fruit drop in mango, fruit set, its retention and factors effecting it. *Indian J. Hort.*, 21: 172-85.
- Chadha, K.L. and R.N. Pal, 1986. *Mangifera indica*. In: Halevy, A.C. (ed.) *CRC Handbook of Flowering*, Vol. 5: 211-30. CRC Press, Boca Raton, Florida.
- Cobin, M., 1950. Mango selection, propagation and culture. *Univ. Florida Agri. Exp. Sta. Ann. Rep.*, pp. 257-9.
- Desai, A.G., V.P. Lionaye and R.T. Gunjate, 1985. Floral biology of Alphanso, Goamaukur and Kesa varieties of mango. *J. Maharashtra Agri. Univ.*, 10: 193-5.
- El-Nabawy, S.M., A.M. El-Hammady, A.S. Khalifa, M.A. Rawash and H.M. El-Masry, 1983. Studies of floral induction, sex expression and fruit drop in relation to alternate bearing habit of 'Langra' and 'Ewais' mango varieties. *Ann. Agri. Sci.*, Ain Shama Univ., Cairo, 28: 1-463.
- FAO, 2000. *Production Yearbook*. Food and Agricultural Organization of the United Nations, Rome.
- Gunjate, R.T., D.P. Jorwekar and B.L. Lad, 1983. Pollination, fruit set and fruit drop in Alphonso mango. *J. Maharashtra Agri. Univ.*, 8: 168-70.
- Hussein, M.A., H.M. Mahmoud, K.I.A. Amen and A.T. Abo-El-Ez, 1989. Comparative studies on sex distribution of some mango varieties *Mangifera indica* L. under Assuit conditions. *Assuit J. Agri. Sci.*, 20: 79-82.
- Iyer, C.P.A., M.C. Subbaiah, M.D. Subramanyam and G.S.P. Rao, 1989. Screening of germplasm and correlation among certain characters in mango. *Acta Hort.*, 231: 83-90.
- Joubert, J.P., P.J. Robbertse, L.A. Coetzer and D.L. Wishart, 1993. Inflorescence characteristics and flower sex ratio studies of container grown mango trees. *S. African Mango Growers' Assoc. Yearbook*, 13: 27-33.
- Khan, M.D and H. Singh, 1946. Floral counts and fruit set studies in mangoes. *Pb. Fruit J.*, 10: 37.
- Kostermans, A.J.G.H. and J.M. Bompard, 1993. *The Mangoes, Their Botany, Nomenclature, Horticulture and Utilization*. Academic Press, London.
- Maheshwari, P., 1934. The Indian Mango. *Current Sci.*, 3: 97.
- Majumdar, P.K. and S.K. Mukherjee, 1961. Studied on the variability of sex expression in mango (*Mangifera indica* L.). *Indian J. Hort.*, 18: 12-9.
- Mukherjee, S.K. 1953. The mango, its Botany, cultivation uses and future improvement, especially as observed in India. *Econ. Bot.*, 7: 130-62.
- Mukherjee, S.K., 1953a. Origin, distribution and phylogenetic affinities of the species of *Mangifera indica* L. *J. Linn. Soc. Bot.*, 55: 65-83.
- Musahib-ud-Din and H.S. Dinsa, 1946. The floral count and fruit set studies in some of the north Indian Mango varieties. *Pb. Fruit J.*, 10: 35-42.
- Nakhlla, F.G. 1980. Physiological studies on mangoes *M.Sc. Thesis*, Zagazig University, Egypt.
- Pimentel, R.B., R.E. Coronel and R.F.C. Espino, 1984. Floral biology and fruit set in mango (*Mangifera indica* L.) cvs. 'Carabao', 'Pico' and 'Kancha Mitha'. *Philippine J. Crop Sci.*, 9: 47-51.
- Popenoe, W., 1917. *Manual of Tropical and Subtropical Fruits*, p. 474. The McMillan Co., New York.
- Purseglove, J.W., 1972. Mangoes west of India. *Acta Hort.*, 24: 107-74.
- Scholefield, P.B. and D.R. Oag, 1984. Flowering and fruit set of six cultivars of mango. *Proc. Ist. Austr. Mango Res. Workshop*, pp: 96-103. CSIRO, Melbourne.
- Singh, R.N., 1971. Biennial bearing in fruit trees. *ICAR Tech. Bull.* (Agri.) No., 30. Ind. Council Agri. Res., New Delhi.

(Received 13 February 2002; Accepted 06 March 2002)