

Studies on physico-morphological characteristics and yield of some mango hybrid lines

M.Z. Uddin, M.S. Islam, M.G. Mortuza¹, M.A.J. Bhuyan² and M. AL-Amin²

Regional Horticulture Research Station, Chapai Nawabgonj, ¹Regional Horticulture Research Station, Ishurdi, ²Horticulture Research Center, Bangladesh Agricultural Research Institute, Gazipur

Abstract: An experiment was carried out with 10 mango hybrids namely Hybrid-001, Hybrid-002, Hybrid-003, Hybrid-004, Hybrid-005, Hybrid-006, Hybrid-009, Hybrid-010, Hybrid-011 and Hybrid-012 at Regional Horticulture Research Station, Chapai Nawabgonj during the fruiting season of 2004 to know the detailed information on plant growth, leaf, inflorescence, fruit characteristics and yield. Among 10 hybrid mango lines, the highest tree volume (155.06 m³) was recorded in Hybrid-006 and the lowest (7.59 m³) in Hybrid-012. The tallest (7.1m) plant was obtained in Hybrid-011 and the shortest (3.00 m) was in Hybrid-012. The longest (28.63 cm) and widest (6.91 cm) leaves were recorded in Hybrid-010 while the shortest (14.61 cm) and narrowest (3.80cm) were noted in Hybrid-009. The longest (34.4 cm) inflorescence was produced by Hybrid-005 and the shortest (23.20 cm) by Hybrid-009. All the mango hybrid lines produced more than 16% perfect flowers with the highest (30%) in Hybrid-001. Hybrid-011 produced dark red inflorescence while others produced light green to light red. Hybrid-003 and Hybrid-010 produced bright yellow fruits at ripen while others produced green or greenish yellow to yellow fruits. The heaviest fruit was obtained from Hybrid-010. The highest (27%) total soluble solid was recorded in Hybrid-005 while the lowest (20.40%) in Hybrid-010. The highest (72.82%) edible portion was observed in Hybrid-009. Number of fruits (67) as well as yield (33.26 kg) was highest in Hybrid-004 and Hybrid-010, respectively.

Key words: Growth, leaf, inflorescence and fruit characteristics, yield, hybrid and mango

Introduction

Mango (*Mangifera indica* L.) is one of the most important fruits of the tropical and sub-tropical regions of the world (Pradhan and Wadhi, 1962; Chadha and Pal, 1993) belongs to the family Anacardiaceae which was originated in the Eastern India, Asam, Myanmar and Malayan region (Mukherjee, 1997) and has been cultivated from 4000 years ago (Candole, 1984). It occupies an area of 61885 hectares of land of Bangladesh with an annual production of 662100 metric tones (BBS, 2005). Almost all the popular commercial mango varieties namely Gopalbhog, Langra, Khirsapat, Fazli, Ashwina etc. which are results of selection of chance seedlings are prone to the phenomenon of alternate or irregular bearing, susceptible to some major diseases or pests and possessing green fruit skin colour although the fruit quality is excellent. On the other hand, an ideal variety having desirable characteristics like high yield, regular bearer, coloured, dwarf, early to late in harvesting period and resistant to insect pests and diseases is still lacking. However, to overcome these problems, development of mango varieties may be an important tool through hybridization and that is why an intensive hybridization programme on mango was initiated at Regional Horticulture Research Station (RHRS), Chapai Nawabgonj since 1993. Forty mango hybrid lines have been developed. Some of the mango hybrid lines have started bearing fruits and their performances are being evaluated in the field condition. As mango hybrids are new aspects to all and information on plant growth, leaf, inflorescence, fruit characteristics and yield of 10 mango hybrid lines grown in Chapai Nawabgonj is scanty. Therefore, the study was undertaken to record detailed information on plant growth, leaf, inflorescence and fruit characteristics and yield of 10 mango hybrid lines grown at Chapai Nawabgonj.

Materials and Methods

The experiment was carried out at Regional Horticulture Research Station (RHRS), Chapai Nawabgonj under the AEZ no.11 (High Ganges River Floodplain) during 2004. Ten mango hybrid lines were included in the study for evaluation. The hybrid lines were Hybrid-001 (Ashwina X

M-3896), Hybrid-002 (Ruby X BARI Aam 1), Hybrid-003 (Palmar X BARI Aam 1), Hybrid-004 (M-3836 X Khirsapat), Hybrid-005 (Ashwina X M-3896), Hybrid-006 (Ruby X BARI Aam 1), Hybrid-009 (Ashwina X M-3896), Hybrid-010 (Ruby X BARI Aam 1), Hybrid-011 (Khirsapat X Ruby) and Hybrid-012 (Kent X BARI Aam 1). The mango hybrid lines were developed in the year 1993. Hybrid fruits were harvested at proper maturity from the mother plant and the stone (F₁ seeds) were sown in earthen pot for germination. Proper care was taken to raise the seedlings. Finally, one year old seedlings were transplanted to the main field in 1994 for evaluation. These 10 mango hybrid lines were considered as the experimental treatments. A single plant constituted a replication and both the distances between plant to plant and row to row were 8m X 8m. The soil was silty clay loams in texture belonging to the High Ganges Floodplain (BARC, 2005) series having pH 6.0- 8.1. During data collection age of the plants was 10 to 11 years. The trees were fertilized as per schedule described by Hossain (1989a). Ripcord 10EC @ 1 ml and Dithane M-45 @ 2 g per liter of water was sprayed with the help of a power sprayer, at panicle and pea stage of fruits to control mango hoppers and anthracnose as per recommendation of Hossain (1989b). Intercultural operations (viz. weeding, mulching etc. were done as and when necessary. Girth of the trunk was measured at a height of 15 cm from ground level and tree volume was calculated by the formula given by Castle (1983) as tree volume = 1/6π X height X (2r)² where, 2r = (east-west + north-south canopy spread)/2. Data on morphological as well as physical and other fruit characters like tree volume (m³), tree height (m), base girth (cm), growth, tree habit, different leaf, inflorescence, quantitative and qualitative characters, number of fruit / tree and yield / tree (kg) were recorded in proper time. Leaf area was measured by using the formula L X B X 0.767 where L is length of lamina, B is breadth of lamina and 0.767 is the correction factor. Yield was calculated by multiplying the number of fruits at harvest and average fruit weight. All the data were recorded following mango descriptor recommended by IBPGR (1989). In

hybridization, one hybrid plant was obtained from each cross. So, only mean, Sd and CV (%) were used.

Results and Discussion

Plant characters: All the mango hybrid lines under study showed diverse characteristics (Table 1). The maximum tree volume (155.06 m³) was recorded in Hybrid-06 followed by Hybrid-011 (152.19 m³) and Hybrid-001 (139.17 m³). The lowest volume was noted in Hybrid-012 (7.59 m³). Hybrid-011 was tallest (10 m) followed by

Hybrid-006 (6.80m) and Hybrid-001 (6.70m). The highest base girth was recorded in Hybrid-011 (100cm) while the least base girth was noted in Hybrid-012 (30cm). It was observed that Hybrid-001, Hybrid-006, Hybrid-009 and Hybrid-011 had vigorous growth while Hybrid-004 and Hybrid-012 had poor growth, others were intermediate. Tree habit of Hybrid-002, Hybrid-004, Hybrid-006 and Hybrid-010 were spreading type while rest of the lines was erect.

Table 1. Plant characteristics of 10 mango hybrid lines

Hybrid lines	Tree volume (m ³)	Plant height (m)	Base girth (cm)	Growth	Tree habit
Hybrid 001	139.17	6.7	77	Vigorous	Erect
Hybrid 002	118.77	6.1	73	Intermediate	Spreading
Hybrid 003	66.75	5.9	66	Intermediate	Erect
Hybrid 004	38.69	5.4	55	Poor	Spreading
Hybrid 005	120.43	6.5	90	Intermediate	Erect
Hybrid 006	155.06	6.8	90	Vigorous	Spreading
Hybrid 009	88.38	5.9	60	Vigorous	Erect
Hybrid 010	62.58	5.3	80	Intermediate	Spreading
Hybrid 011	152.19	7.1	100	Vigorous	Erect
Hybrid 012	7.59	3.0	30	Poor	Erect
Mean	94.69	5.87	72.10	-	-
S.D.	47.69	1.11	19.38	-	-
C.V.(%)	50.22	18.91	26.88	-	-

Table 2. Leaf characteristics of 10 mango hybrid lines

Hybrid lines	Length of lamina(cm)	Breadth of lamina(cm)	Leaf area(m ²)	Length of petiole(cm)	Leaf shape	Leaf tip	Leaf margin
Hybrid 001	23.34	5.63	100.79	2.40	lanceolate	Acuminate	Flate
Hybrid 002	17.51	4.62	60.59	3.25	Elliptic lanceolate	Acuminate	Flate
Hybrid 003	22.58	6.04	104.61	3.73	lanceolate	Acuminate	Wavy
Hybrid 004	19.38	4.68	69.57	2.17	lanceolate	Acute	Flate
Hybrid 005	18.11	4.23	58.76	2.75	lanceolate	Acuminate	Flate
Hybrid 006	20.50	5.15	80.98	2.80	lanceolate	Acuminate	Wavy
Hybrid 009	14.61	3.80	42.58	2.65	lanceolate	Acute	Flate
Hybrid 010	28.63	6.51	142.95	4.43	Oblong lanceolate	Acuminate	Flate
Hybrid 011	21.98	5.79	97.61	4.50	lanceolate	Acute	Flate
Hybrid 012	17.11	5.01	65.75	3.04	lanceolate	Acute	Flate
Mean	20.38	5.15	82.47	3.17	-	-	-
S.D.	3.78	0.80	27.90	0.77	-	-	-
C.V.(%)	18.54	15.53	33.83	24.29	-	-	-

Leaf characters: The longest leaf lamina (28.63 cm) was recorded in Hybrid-010 followed by hybrid-001 (23.34 cm) and Hybrid-003 (22.58 cm). The shortest lamina (14.61 cm) was noted in Hybrid-009. The highest breadth of leaves (6.51 cm) was noted in Hybrid-010 followed by Hybrid-003 (6.04 cm). The narrowest leaves (3.80 cm) were noted in Hybrid-009. The longest petiole (4.50 cm) was recorded in Hybrid-011 while shortest petiole (2.17 cm) was noted in hybrid-004. Among the lines, the highest leaf area (142.95 m²) was recorded in Hybrid-010 and the lowest (42.58 m²) in Hybrid-009. Shape of the leaves of almost all lines was lanceolate except Hybrid-002 and Hybrid-010. They were elliptic lanceolate and oblong lanceolate, respectively. Hybrid-004, Hybrid-009, Hybrid-011 and Hybrid-012 have acute leaf tip while others have acuminate. Leaf margin of all lines under study was flat except Hybrid-003 and Hybrid-006, which were wavy.

Inflorescence characters: Diversity of inflorescence characters of the hybrid lines are presented in Table 3. All

hybrid lines produced inflorescence in both terminal and auxillary except Hybrid-002 which produced only in terminal. Shape of the inflorescence was conical in Hybrid-002, hybrid-004, Hybrid-005 and hybrid-012 while rest of the lines was pyramidal. The longest panicle produced by Hybrid-005 followed by Hybrid-003 (32.5 cm) and Hybrid-006 (30.5 cm) while shortest panicle by Hybrid-009 (23.2 cm). Hybrid-011 produced dark red panicle and others produced light green to light red while some produced green with red patches. Leafy bract was absent in all lines except Hybrid-003 and Hybrid-009. All hybrid lines produced pentamerous flowers while Hybrid-002 and Hybrid-009 sometimes produced some tetramerous flowers. All the lines under study produced considerable amount (average 20.91%) of perfect flowers. The highest number (30.0%) of perfect flowers was recorded in Hybrid-001 while lowest in Hybrid-004 (15.0 %).

Table 3. Inflorescence characteristics of 10 mango hybrid lines

Hybrid lines	Inflorescence				Flower density	Leafy bract	Type of flower	Perfect flower(%)
	position	shape	length(cm)	colour				
Hybrid 001	T&A	Pyramidal	30.3	LR	Laxly	Absent	Pentamerous	30.00
Hybrid 002	Terminal	Conical	28.9	LR	Densely	Absent	Pentamerous	27.10
Hybrid 003	T&A	Pyramidal	32.5	GRP	Densely	Present	P&T	23.50
Hybrid 004	T&A	Conical	26.8	LG	Laxly	Absent	Pentamerous	15.00
Hybrid 005	T&A	Conical	34.4	LG	Densely	Absent	Pentamerous	24.40
Hybrid 006	T&A	Pyramidal	30.5	LR	Densely	Absent	Pentamerous	20.20
Hybrid 009	T&A	Pyramidal	23.2	LR	Densely	Present	Pentamerous	19.50
Hybrid 010	T&A	Pyramidal	26.1	GRP	Densely	Absent	P&T	16.15
Hybrid 011	T&A	Pyramidal	29.8	DR	Laxly	Absent	Pentamerous	16.00
Hybrid 012	T&A	Conical	23.0	LR	Laxly	Absent	Pentamerous	17.20
Mean	-	-	28.55	-	-	-	-	20.91
S.D.	-	-	3.56	-	-	-	-	4.88
C.V.(%)	-	-	12.47	-	-	-	-	23.34

Table 4. Qualitative characteristics of fruits of 10 mango hybrid lines

Hybrid lines	Colour at ripen	Shape	Eating quality	Fibre on stone
Hybrid 001	Green	Oblong	Poor	Absent
Hybrid 002	GY	Oblong	Intermediate	Present
Hybrid 003	BY	Roundish	Intermediate	Present
Hybrid 004	Yellow	Roundish	good	Absent
Hybrid 005	Green	Oblong	Intermediate	Present
Hybrid 006	GY	Oblong	Intermediate	Present
Hybrid 009	GY	Roundish	Intermediate	Absent
Hybrid 010	BY	Oblong	good	Absent
Hybrid 011	Green	Green	Intermediate	Present
Hybrid 012	Green	Green	Intermediate	Absent

GY= Greenish yellow, BY= Bright yellow

Table 5. Quantitative characteristics of 10 mango hybrid lines

Hybrid lines	Wt. of fruit(g)	Fruit size (cm)			Edible Portion (%)	TSS (%)	No. of fruits/tree				Average Yield/tree (kg)
		Length	Breadth	Thickness			2002	2003	2004	Average	
Hybrid 001	144.00	8.38	5.88	5.22	68.75	24.0	20	48	82	50.00	7.20
Hybrid 002	250.00	9.09	7.60	6.30	64.00	24.0	27	62	74	54.33	13.58
Hybrid 003	140.00	7.62	5.80	5.04	58.57	21.0	35	68	92	65.00	9.10
Hybrid 004	184.00	8.02	6.44	5.78	64.13	25.0	32	73	96	67.00	12.33
Hybrid 005	104.00	6.16	5.16	4.64	63.46	27.0	25	61	70	52.00	5.41
Hybrid 006	297.50	10.30	7.45	6.80	68.91	24.5	35	47	66	49.33	14.68
Hybrid 009	412.00	10.54	8.24	7.30	72.82	25.0	22	55	60	45.67	18.82
Hybrid 010	504.00	14.16	8.32	7.10	62.70	20.4	30	66	102	66.00	33.26
Hybrid 011	331.70	11.17	7.70	6.03	67.84	24.2	28	56	72	52.00	17.25
Hybrid 012	175.00	9.48	5.70	5.36	65.71	25.6	10	22	30	20.67	3.62
Mean	254.15	9.49	6.83	6.14	65.69	24.07	-	-	-	52.20	13.53
Sd.	124.11	2.11	1.10	0.75	3.81	1.89	-	-	-	12.76	8.11
CV(%)	48.83	22.23	16.11	12.21	5.80	7.85	-	-	-	24.44	59.94

Fruit characters: Wide range of variability was observed in qualitative characteristics of fruits under study (Table 4 and plate 1). Fruits of Hybrid-003 and Hybrid-010 became bright yellow at ripen while fruits of hybrid-001, Hybrid-005 and Hybrid-011 and Hybrid-012 were green. The variation in colour development might be due to genetic factor conforming to the findings of Mukherjee (1997) and Uddin *et al.* (1998). Fruits of Hybrid-003, Hybrid-004 and Hybrid-009 were roundish in shape while others were oblong. Hybrid-004 and Hybrid-010 had very good eating quality while rests of the lines were intermediate. Stone of Hybrid-001, Hybrid-004, Hybrid-009, Hybrid-010 and Hybrid-012 were free from fiber while others had medium fiber.

Wide range of variability was also noted in the quantitative characteristics of fruits of mango hybrid lines (Table 5 and Plate 1). Among the lines, Hybrid-010 produced the heaviest fruit (504.0 g) followed by Hybrid-

009 (412.0 g) and Hybrid-011 (331.0 g) while the lightest fruit was produced by Hybrid-005 (104.0 g). Other lines produced intermediate fruits. According to the classification described by Samson (1980) the fruits produced by Hybrid-010, Hybrid-009 and Hybrid-011 may be termed as large size, Hybrid-006, Hybrid-002 as medium and rest of the hybrid as small size fruit. Hybrid-010 produced the longest (14.16 cm) and widest fruit (8.32 cm). The shortest fruit was obtained from hybrid-005 (6.16 cm). The highest (27%) total soluble solid (TSS) was recorded in Hybrid-005 and lowest (20.4%) in Hybrid-010. Edible portion was highest (72.82 %) in Hybrid-009 while it was lowest (58.57 %) in Hybrid-003. The result partially agreed with those of Sarder, *et al.* (1998) as they reported the range from 54.6 to 67.5 % and the result of Uddin, *et al.* (2004) where they reported the range from 54.16 to 81.62 %.

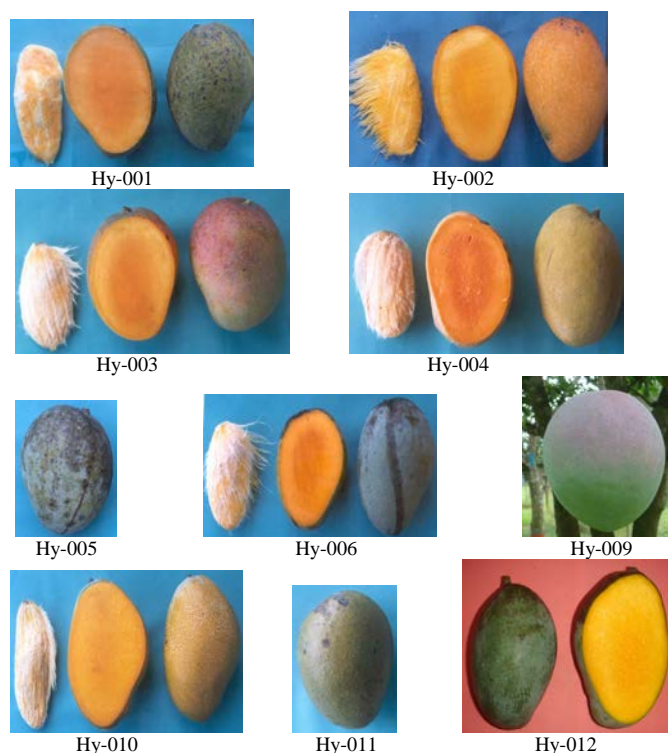


Plate 1. Fruits characteristics of mango hybrid lines Hy-001, Hy-002, Hy-003, Hy-004, Hy-005, Hy-006, Hy-009, Hy-010, Hy-011 and Hy-012

Yield: Number of fruits and yield of the mango hybrid lines are presented in Table 5 continued. Maximum average number of fruits (67.00) was obtained from Hybrid-004 followed by Hybrid-010 (66.00) and Hybrid-003 (65.00) where as minimum number of fruits (20.67) was obtained from Hybrid-012. The highest yield per tree (33.26 kg) was obtained from Hybrid-010 while the lowest (3.62 kg) was in Hybrid-012. Rest of the mango hybrid lines gave moderate to lower yield. The number of fruit produced by the plant and the yield of mango variety greatly depending upon the variety, tree condition and agro climatic conditions of the growing region (Singh, 1990).

The present study revealed that considering overall performances especially yield, number of fruits and even percent edible portion, colour, eating quality and total soluble solids (TSS), Hybrid-010, Hybrid-011, Hybrid-009 and Hybrid-004 were the best among the mango hybrid lines grown at Chapai Nawabgonj conditions.

References

- BARC. 2005. Fertilizer Recommendation Guide-2005. Farmgate, Dhaka-1215. p. 16 & 22.
- BBS, 2009. Monthly Statistical Bulletin- Bangladesh. Agricultural Wing. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh. p. 61.
- Candole, A.D. 1984. Origin of Cultivated Plants. Vegal Paul Trench and Co. London, PP. 1-67.
- Castle, S.W. 1983. Growth, Yield and Cold Hardiness of seven year old "Bears" Lemon trees on twenty seven rootstocks. Proc. Fla. State Hort. Soc., 96:23-25.
- Chadha, K. L. and R. N. Pal. 1993. The current status of the mango industry in Asia. Acta Hort., 341: 206-212.
- Hossain, A.K.M.A. 1989a. Manual on Mango Cultivation in Bangladesh. Horticulture Division, BARI, and FAO/UNDP Mango Improvement and Development (BGD/81/022). Gazipur, Bangladesh. pp 40-41.
- Hossain, A.K.M.A. 1989b. A Field Guide on Insect Pests and Diseases of Mango in Bangladesh and Their Control. Hort. Div., BARI and FAO/UNDP Mango Improvement and Development (BGD/81/022). pp 3-29.
- IBPGR, 1989. Descriptors for Mango. International Board of Plant Genetic Resources, Rome Italy. P. 9.
- Mukherjee, S.K. 1997. Introduction, botany and importance. In: The Mango: Botany, Production and Uses. 1st edition (R.E. Litz Ed.), CAB International, Wallingford, UK. pp.1-19.
- Pradhan, S. and S. R. Wadhi. 1962. Quarantine problems facing the introduction of mango. Bull. Nalt. Inst.Sci., India,19:106-118.
- Saha,A.K. and A.K.M. Amzad Hossain,1988. Studies on fruit characteristics of some grafted mango cultivars Bangladesh J. Agric. Res. 13(2):47-52.
- Samson,J.A.1980. Tropical Fruits. Longman Group Ltd. London. 234p.
- Sarder,P.K.,M.A.Hossain and Sharfuddin,A.F.M.1998. Physico-chemical studies of some mango varieties grown in Bangladesh. Bangladesh Hort.26 (1 & 2): 49-51.
- Singh,R.N. 1990. Mango. Indian Council of Agricultural Research, New Delhi.pp.46-65
- Uddin, M.Z.2004. Characterization of different mango germplasm under Mymensingh conditions. An M.S. (Hort.) Theiss. Dept. of Horticulture . Bangladesh Agriculture University, Mymensingh.p.149.
- Uddin,M.S.,M.M.A.Patwary and M.A.Salam.1998. Growth, flowering behaviour and fruit characteristics of promising mango lines. Bangladesh Hort.,26 (1&2):41-44.