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Evaluation of Mango Varieties for Growth, Yield and Quality Parameters in Venkatagiri, Nellore District

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Eighteen mango varieties comprising of six hybrids and twelve other varieties comprising of table, juicy, regular, offseason and pickle varieties were evaluated at CRS, Petlur, Venkatagiri, Nellore dist. during December to June 2011-2013 to find out the suitable variety. The earliest flowering as well as harvesting were observed in AU Rumani, Khader, Pulihora.Number of fruits per tree varied from 22 to 305. Maximum number of fruits (305) per tree were obtained from Pulihora, while minimum fruits (22) Khader. The heaviest fruit (748 gm) was obtained from Hamlet, while the lightest fruit (145 gm) was in Pulihora. Maximum yield per plant was found in Banglora (1145 kg) whereas it was lowest in Khader (130 kg).The high pulp edible portion (78.66%) was recorded in KMH-1,Baneshan.The highest TSS content (21.2%) was recorded in Peddarasam, whereas the lowest TSS content (8.2%) was observed in Hamlet. Among hybrids KMH-1, table varieties Baneshan, Khader, juicy variety Peddarasam, regular bearing varieties Banglora and Neelum, pickle variety Allipasand was found superior and best suitable for cultivation in Venkatagiri, Nellore district

Key words*: Growth, Flowering, Fruit characteristics, Mango.*

Mango (*Mangifera indica* L.), a tropical and sub-tropical fruit, belongs to the family Anacardiaceae, which was originated in South Asia/Malayan Archipelago and has been in cultivation for more than 4000 years (Mukherjee, 1949; Candole, 1984; Bose, 1985). It is an important and popular fruit in the world for its excellent flavors, attractive color, delicious taste, and high nutritive value.

India ranks first among world's mango producing countries accounting for about 50% of the world's mango production. Other major mango producing countries include China, Thailand, Mexico, Pakistan, Philippines, Indonesia, Brazil, Nigeria and Egypt. India's share is around 52% of world production i.e. 19 million tonnes as against world's production of 33 million tonnes (2012-13). Of the total fruit production in India, mango accounted for 52 per cent. In case of Andhra Pradesh, area under mango cultivation increased from a mere 0.6 lakh ha. in 1951-52 to 10.2 lakh ha. in 2012-13. The total world production during 2012 was around 38 million metric tonnes (MT) where India enjoys the top slot (17.8 million MT) followed by China (7.67 million MT), Thailand (2.8 million MT), Mexico (2.5 million MT), etc.

The major mango growing states in India are UP, Gujarat, Andhra Pradesh, Maharashtra, Orissa, Bihar, West Bengal, Karnataka. Goa, Haryana, MP, Punjab and TN. The region wise popular varieties grown in different parts of the country comprise Alphonso and Kesar from Western India, Banganpalli, Alphanso, Totapuri and Neelam from southern states, Fazli from Eastern States and Langra, Chausa and Dusheri from Northern States.

Area-wise, Andhra Pradesh occupies 30 per cent of the total area under mango in the country, next to Maharashtra (29%) and followed by UP (17.6%), Bihar (9%) and Orissa (7%). Among the several varieties grown in Andhra Pradesh, Banganapalli or Baneshan occupies a predominant place at more than 70 per cent of the total area under mango. It is predominantly grown in Kadapa, Chitoor, Ananthapur, Krishna district, which is the major mango-growing belt in Andhra Pradesh. The production of mangoes in Andhra Pradesh is around 3445 MT in an area of 4.5 lakh hectares.(*National Horticulture Board, Ministry of Agriculture , Govt. of India.2012)*

The crop accounts for 39% of area under fruit corps in India and 23% of production of these crops.

In general, the cultivars are location specific and the commercial varieties of one region may not do so well when grown in other areas

(Majumder *et al*., 2001). Information regarding the performances of the released mango varieties is scanty under Nellore condition. Therefore, the present investigation was undertaken to evaluate the performance of mango varieties developed by various institutes under hot and humid climatic condition of Nellore region.

MATERIAL AND METHODS

The experiment was conducted at the Citrus Research Station, Petlur, Venkatagiri, Nellore district during 2011-2013. The plants are planted during the year 1993, 1996 planted at 8 x8 mt spacing in the farm . The soil is red loamy type and the temperatures are very hot which reaches up to 47 degrees during summer months and dry weather persists for almost nine months in a year. Six plants in each variety at a distance of 8x8 mt were planted and-maintained. The irrigation is carried out through drip with 16 mm lateral pipes.

Eighteen mango varieties comprising of six hybrids namely Swarna Jehangir, Neeluddin, Neelgoa, KMH-I, A U Rumani, Neeleshan, four table varieties comprising of Baneshan, Jehangir, Khader, Malgoa, one juicy variety Peddarasam, regular bearing varieties comprising of Neelum, Banglora, Rumani, Pulihora , two pickle varieties comprising of Alipasand, Hamlet and one off season variety Royal Special were included in this study. Statistical analysis was performed using excel data analysis tool pack annova two factor without replication

The performance in term of vegetative growth charac-ters, yield efficency and fruit quality characters were studied. The data for all the parameters was recorded during 2011 and 2013 and was pooled. Collapsible pvc pole, calibrated in feet and inches was used to measure the height of each sample plant. Height was measured from the bud union to the top of plant. Tree size was derived in term of Canopy Volume (CV) with the help of calculation, CV = 0.524hd2 which is one-half of a prolate spheroid with hdenoting as tree height while d donate average of N-S and E-W diameters. Scion and stock circumference were measured with the help of measuring tape, just above and below the bud union. The weight of fruit sample of different mango varieties under testing was taken with the help of simple pan balance. Ten fruits of mango were randomly taken as sample from each tree. Average fruit weight was calculated in grams/fruit. Fruit size, length and breadth were recorded with the help of vernier caliper and their average was calculated in centimeters. The color of fruit was assessed on the basis of Royal Color Chart. These observations were taken at the optimum maturity of the fruit. Pulp eight was calculated by subtracting the peel and stone weight from total weight of fruit. Pulp content was expressed in percentage. To calculate pulp/stone ratio the stone weight was subtracted from the total weight of fruit and the value obtained was divided by stone weight.

The trees were fertilized as per schedule described by Hossain (1989). Monochrotophos 2 ml along with Dithane M- 45 @ 2 g per litre of water was sprayed with the help of a power sprayer at panicle emergence (before anthesis) and pea stage of fruits to control mango hoppers and anthracnose as per recommendation. Fertilizers were applied twice in a year in June and September 2011-2013. Irrigation was done at pea stage of fruit on April 2011-13. Other intercultural operations, such as weeding, ploughing, and mulching were done as and when necessary.

Data on plant height, flowering, mean yield per plant, fruit weight, number of fruits per tree, TSS content, specific gravity, rind color, rind thickness, rind percentage, pulp color, pulp thickness, edible portion, fruit size (length, diameter), stone percentage, brix were recorded. The data were recorded following mango descriptor recommended by IBPGR (2006). Organoleptic evaluation was done to determine the pulp color, sweetness, aroma, texture, juiciness, fibrousness, peeling quality, eye appeal, and general quality of fruits of different genotypes based on the criteria of the score card as follows :a) Pulp color: 1- light yellow, 2- yellow, 3- bright yellow; b) Sweetness/ Taste: 1- insipid, 2- sweet, 3- very sweet; c) Aroma: 1- very slight, 2- pleasant, 3- delightful; d) Texture: 1- firm, 2- medium, 3- soft; e) Juiciness: 1- scantly, 2- much, 3- abundant; f) Fibrousness: 1- abundant, 2- much, 3- scanty g) Peeling quality: 1- hard, 2- medium, 3- easy h) Eye appeal: 1- poor, 2- good, 3- very good (Uddin *et al*., 2007).

RESULTS AND DISCUSSION

The investigation revealed that growth of mango varieties varied significantly for all the parameters (Table 1).

Table 1. The data on growth and yield of different mango hybrids /varieties.

S.No.	Name of the hybrid/ variety	Date of flowering	Mean plant			Mean yield/plant		Pooled yield/plant		Date of harvesting
			Height (m)	Scion/R.S Ratio	Volume (cu.m)	No.	Wt./Tree (Kg)	No.	Wt./Tree (Kg)	
	Hybrids									
1	A.U.Rumani	10-12-2012	5.92	1.12	80.12	——	——-	790.95	238.94	30-3-2013
2	Swarna Jehangir	01-02-2103	6.88	1.13	132.19	243.00	89.60	3084.63	803.37	25-4-2013
3	Neeluddin	04-02-2013	6.12	1.03	121.06	168.50	44.58	2877.95	757.70	01-5-2013
4	Neelgoa	06-02-2013	5.90	1.11	120.31	185.40	50.20	2776.80	754.36	01-5-2013
5	Neeleshan	06-02-2013	6.85	1.02	171.32	216.66	63.72	3304.30	687.82	06-5-2013
6	KMH-1	03-03-2013	6.37	1.13	106.83	85.60	23.86	808.75	281.51	02-6-2013
	Table Variety									
7	Baneshan	10-03-2013	7.91	1.08	225.60	186.16	56.73	1960.20	476.55	30-5-2013
8	Mulgoa	07-02-2013	4.95	0.98	67.54	83.16	37.91	384.80	201.23	04-6-2013
9	Jahangir	04-02-2103	5.42	1.22	73.54	45.83	24.35	1205.37	431.30	25-5-2013
10	Khader	28-12-2012	3.88	1.02	120.20	22.66	4.68	763.70	130.65	18-3-2013
	Juicy Variety									
11	Peddarasam	01-02-2013	7.56	1.05	210.36	148.00	43.66	2150.40	591.73	10-5-2013
	Regular Variety									
12	Neelum	02-03-2013	7.91	1.15	205.60	113.40	25.08	3722.70	679.42	10-6-2013
13	Bangalora	01-02-2013	7.55	1.11	259.57	252.00	88.20	5267.80	1145.35	12-6-2013
14	Rumani	08-12-2012	4.86	1.10	53.26	295.40	46.42	2957.80	703.26	01-4-2013
15	Pulihora	10-12-2012	6.74	1.01	180.25	305.80	48.87	5882.30	815.25	03-4-2013
	Pickle Variety									
16	Allipasand	03-03-2013	5.62	1.15	65.34	273.33	65.58	2571.00	587.58	02-6-2013
17	Hamlet	04-02-2013	7.24	1.21	170.54	47.33	34.78	1344.20	949.15	15-5-2013
	Off Season Variety									
18	Royal special	24-03-2013	7.86	1.13	134.62	74.80	14.60	1137.01	310.94	15-6-2013
	CD (p=0.05)		0.19	N.S.	22.65	10.95	3.87	55.21	16.82	
	SE(d)		0.09	0.99	11.10	5.35	1.89	27.05	8.24	
	SE(m)		0.06	0.70	7.84	3.78	1.33	19.10	5.83	
	CV(%)		1.98	102.00	10.16	4.16	5.44	1.40	1.78	

Table 2. Physico-Chemical Analysis of Fruits of Mango Hybrids/Varieties.

S.No	Hybrid/ variety	Average wt.(g)	Length (cm)	Dia. (cm)		Sp.Gr.	Rind color	Rind Thickness (mm)	Rind (%)	Pulp colour	Pulp Thickness	Pulp (%)	Stone (%)	Brix(o)	TSS	Acidity
				Max.	Min											
1	Swarna	334.6	11.2	4.1	3.5	0.7	Y	1.5	17.7	LY	2.0	67.4	16.5	17.5	16.8	0.34
2	Neeluddin	180.3	9.7	3.4	2.7	0.6	L.Y	0.4	15.8	LY	1.7	68.4	17.0	24.2	16.0	0.3
3	Neelgoa	271.6	9.6	3.8	3.1	0.4	L Y	0.4	13.5	Y	2.2	61.0	18.0	25.0	16.4	0.3
4	Neeleshan	340.0	10.3	4.5	3.7	0.7	LY	1.0	15.4	LY	2.5	64.1	16.1	22.0	16.2	0.3
5	KMH 1	279.3	12.4	3.7	3.7	0.8	GY	0.8	11.4	Y	2.5	74.1	16.0	20.4	18.6	0.3
6	Baneshan	393.3	11.6	4.3	3.5	0.8	Y	1.1	15.7	DY	2.4	70.0	15.1	22.4	18.2	0.4
7	Jehangir	540.0	11.7	4.5	4.4	0.7	LY	1.1	12.2	Y	3.2	79.0	11.2	19.1	14.2	0.3
8	Khader	221.6	8.7	4.0	3.7	0.9	RY	1.1	12.5	Y	2.2	68.4	13.1	21.1	18.3	0.33
9	Peddarasam	326.6	13.2	4.0	3.5	0.9	GY	0.2	10.1	Y	-	75.3	15.1	19.7	21.2	0.3
10	Neelum	230.0	9.8	4.1	3.5	0.8	GY	0.3	16.4	Y	2.1	62.0	19.2	24.3	16.8	0.3
11	Banglora	405.0	13.6		3.6	0.4	GY	0.7	16.1	DY	2.1	65.0	13.2	18.3	13.2	0.2
12	Rumani	165.0	6.8	4.2	3.5	0.8	Y	0.4	12.6	DY	2.1	69.2	14.1	21.1	16.8	0.3
13	Pulihora	145.0	9.4	3.0	3.6	0.8	RY	0.4	17.3	DY	1.3	69.3	15.2	23.2	16.8	0.3
14	Alipasand	239.6	9.8	4.2	3.6	0.7	G	0.6	7.2	CW	2.6	78.1	13.1	14.2	10.3	0.2
15	Hamlet	747.6	17.6	4.7	4.7	0.7	G	0.6	13.0	CW	3.0	72.3	13.2	14.4	8.2	0.2
	CD(p=0.05)	15.2	0.38	0.28	0.21	0.16		0.15	0.22		0.15	1.12	0.28	0.18	0.59	0.77
	SE(d)	7.4	0.18	0.13	0.10	0.08		0.07	0.10		0.07	054	014	0.08		
	SE(m)	5.2	0.13	0.09	0.07	0.05		0.05	0.07		0.05	0.38	0.09	0.06		
	CV(%)	2.8	2.08	4.13	3.46	13.2		12.00	0.90		4.33	0.96	1.05	0.52		

The highest tree volume (259.57 cu m) was produced by Banglora, whereas the lowest 53.26 cu m) in Rumani. Highest plant height was observed in Neelum and Baneshan (7.91 m) followed by Banglora, Hamlet, Royal Special (7.2 -7.8 m),while the lowest in Rumani (4.86 m). Scion stock ratio was maximum in Hamlet (1.21) and minimum in Malgoa (0.98). The other varieties had intermediate scion stock ratio.

The flowering of all the varieties varied and the early flowering were Rumani, AU Rumani, Pulihora, Khader, flowering took place in between 1-12-2012 to 28-12-2012 and harvesting period was in between 30-3-2013 to 3-4-2013. The mid season flowering varieties were Swarna jehangir, Neeluddin, Neelgoa Neeleshan, Peddarasam, Banglora, Hamlet, where flowering was observed between 1-2-2013 to 6-2-2013 and harvesting period was in between 25-4-2013 to 10-5-2013. Late flowering was observed in KMH-1, Baneshan, Neelum, Royal Special in between 3-3-2013 to 24-3-2013 and harvesting was in between 30-5-2013 to 15-6-2013. The variability in relation to flowering and harvesting found in the present study is in agreement with the findings of Valmayor (1962) who reported that the variation of blooming period and harvesting was dependent upon the combination of environmental factors and the condition of the plant.

The harvesting period varied from March to June. Among the varieties, the fruits of Khader, AU Rumani, Rumani Pulihora matured on March, while the fruits of KMH-1, Baneshan, Banglora matured on June. Other varieties were intermediate in fruit maturity. The result supports the findings of Hossain (1989) who reported that fruits of mango mature within 4-5 months of flowering.

Table 3 .Organoleptic characteristics of mango varieties.

Variety	Pulp color	Taste	Aroma	Juiciness	Fibrousness	Peeling quality	Eye appeal	General quality
Swarna Jehangir	2	2	2	1	3	2	2	2
Neeluddin	1	2	2	1	2	2	2	2
Neelgoa	1	2	2	1	2	2	2	2
Neeleshan	1	2	2	1	2	2	2	2
KMH-1	2	3	3	1	3	3	3	3
Baneshan	3	3	3	1	3	3	3	3
Khader	3	3	3	1	3	3	3	3
Peddarasam	1	3	3	3	1	1	2	3
AU Rumani	2	3	3	1	3	3	2	3
Banglora	2	1	2	2	3	3	3	3
Hamlet	1	1	1	1	3	3	2	2

Among the varieties maximum number of fruits per tree was recorded in Pulihora, Swarna Jehangir, Rumani, Banglora, Neeleshan (243-305), intermediate number of fruits in varieties Neeluddin, Baneshan, Peddarasam (113-185) and minimum in Khader (23). Maximum pooled weight of fruits was recorded in Banglora (1145 kg) followed by Hamlet (949 Kg) and minimum was in Malgoa (131 kg) . The number of fruits per tree varied depending upon the variety (Singh, 1990)

The heaviest fruit (748 g) was obtained from Hamlet, followed by Banglora, Baneshan, Peddarasam, Jehangir (330 to 405 g) whereas the lightest fruits were Pulihora and Rumani (145-165 g) This variation might be due to genetic differences among the varieties. Uddin *et al*. (2007) also reported variable fruit weight in different mango varieties.

The longest fruit (17.6 cm) was recorded in Hamlet followed by Peddarasam, Banglora, Neeleshan, Swarna Jehangir (11.2 – 13.6 cm) and minimum was recorded in Khader (8.7 cm). Maximum diameter was recorded in Hamlet (4.7 cm) and minimum was recorded in Pulihora. Highest specific gravity was recorded in Peddarasam (0.9) and minimum was recorded in Neelgoa and Banglora (0.4) Mollah and Siddique (1973) and Saha and Hossain (1988) also found different fruit sizes in different mango varieties.

Fruit production pooled weight per plant was highest in Banglora (1146 kg) and lowest was in Khader (131 kg). The stone percentage was high in Neelum, Neelgoa, Neeluddin Swarna Jehangir (16-19%) followed by Baneshan, Peddarasam (15%) and minimum was recorded in Jehangir (11.2%) .

Percent edible portion and per cent TSS of fruits are the two most important criteria of quality mango. These were significantly different among the varieties (Table 2). The pulp percentage was highest in Jehangir, KMH-I, Baneshan, Alipasand, Hamlet (70- 78%) and average of (62-68%) in other varieties. The findings of the present study are in good agreement with that of Haque *et al*. (1993).

The highest TSS content in fruit juice (21.2%) was recorded in Peddarasam followed by Khader and KMH-1, Baneshan in the range of (17-18%). The varieties in the range of 15-16% were Swarna Jehangir, Neeluddin, Neeleshan, Neelum, Rumani. The lowest TSS (8.2%) was observed in Hamlet. The results are in conformity with Haque *et al*. (1993) who recorded 15.0, 20.0 and 19.0% TSS in Badshabhog, Himsagar, and Bishawanath,varieties respectively under Nawabgonj condition.

Organoleptic characteristics of mango varieties are shown in Table 3. In respect of pulp color, the highest score (3) was obtained in Khader, Baneshan followed by KMH-1,Swarna Jehangir and the lowest in Peddarasam (1). In respect of taste Baneshan, Peddarasam, KMH-1, AU Rumani

ranked the highest score (3) and the lowest (1) in Hamlet. In respect of aroma Khader, Baneshan, Peddrasam, AU Rumani had highest (3) and lowest in Hamlet. In case of juiciness, the highest (3) score was found in Peddarasam and low in all other varieties. Maximum fibre was found in Peddarasam (3), while the lowest in Banglora, Hamlet (1) . Peeling quality was best in Baneshan, KMH-1, Khader, and lowest in Pedddarasam. The present results are in accordance with the findings of Uddin *et al.,* 2007 who mentioned the variable score in different mango genotypes.

Conclusion

Among the mango varieties Hybrid KMH-1 was found superior considering texture, fruit colour, and aroma, among table varieties Baneshan, Khader was superior, among juicy variety Peddarasam was superior, among regular bearing varieties Banglora and Neelum were superior among pickle variety Allipasand was found superior and best suitable for cultivation in Venkatagiri, Nellore district with minimum infestation by insect pests and diseases.

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