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Article · January 2015

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Heirloom/Seedling Mango Varieties of India – Potentialities and Future

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(Received: 14 January 2015; Revised: 04 March 2015; Accepted: 13 March 2015)

Mango is very widely distributed in India with more than one thousand varieties throughout the tropical and subtropical regions. Most of these varieties are of Seedling origin and are found to be growing as heirloom varieties from generation to generation. Survey carried out under the UNEP-GEF TFT project in the four sites viz., Chittoor, Amravathi, Pusa and Malihabad resulted in the documentation of Seedling types, which showed desirable traits in them. These varieties evaluated *in situ*, *ex situ* resulted in indicating the desirable traits, which would help in introgression through breeding. The promising among them were registered. Some of these heirloom varieties can be directly adopted for commercial cultivation. The diversity analysis based on the morphological characteristics showed similar trend as the molecular characterization.

Key Words: Diversity, Heirloom, Indigenous, Mango, Variability

Introduction

The mango in India has more than one thousand varieties belonging to *Mangifera indica* and is spread throughout the country (Mukherjee, 1963). Many of today's commercial varieties viz., Alphonso, Imam pasand etc., are heirloom varieties, which indicates that these are inherited from their ancestors. Survey carried out under the UNEP-GEF TFT project in the four sites viz., Chittoor, Amravathi, Pusa and Malihabad resulted in the documentation of Seedling types, which showed desirable traits. The Seedling progenies were observed to be growing in large numbers in these regions. These were located, evaluated and registered. The information gathered from the selected community indicated that farmers are maintaining these varieties for different purposes viz., pickling and for use during various occasions. These varieties evaluated *in situ*, *ex situ* resulted in indicating the desirable traits, which would help in introgression through breeding. The inter-site diversity studied for certain fruit characteristics showed that the Seedling types followed the diversity trend in recording the variability. This would not only help the

farmers in conservation but also help in deriving benefit out of these by registering them as farmer's variety.

Materials and Methods

A total of 68 indigenous types spreading across the villages in the four sites viz., were identified through a participatory four-cell analysis and baseline survey in the three communities to assess on-farm community diversity. In this survey 1175 households were interviewed in the communities to locate the seedling types (*naati*). Out of these 38 indigenous types, 10 elite types having unique fruit quality traits were identified by evaluating these accessions *ex situ* in five replications during the second year. The varieties once identified in the farmers' orchard were evaluated *in situ* by interviewing the farmers. Those of the Seedling varieties, which had desirable morphological traits viz., peel colour, good shape and size were selected when they were mature and the ripe fruits were evaluated for eating quality, appearance and pulp quality *in situ*.

During the second season, the varieties were evaluated *ex situ* for the fruit quality parameters, which are distinct, unique and stable viz., fruit weight, fruit

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length, fruit breadth, TSS, peel thickness, pulp colour, pulp percentage, keeping quality, total carotenoids and were also characterized using molecular tools to confirm that they are different from other varieties. It was also ensured that there are no duplicates in these Seedlings. Taking all these parameters, the varieties were selected for different purposes.

Thirty-eight indigenous mango varieties from *Chittoor* region, 70 varieties from *Pusa*, 12 varieties from *Amravati* and 115 varieties from *Malihabad* were evaluated for fruit characteristics and the trait specific characteristics for each of the varieties was indicated. Diversity analysis for the indigenous varieties from the four sites was carried out and cluster diagram was drawn using the Ward's method using PAST software. For each of the sites commercial varieties of different regions viz., *Alphonso*, *Neelum* and *Totapuri* for *Chittoor*, *Dashehari* and *Langra* for *Malihabad* region, *Alphonso* and *Mankurd* for *Amravati* and *Sukul* and *Langra* for *Pusa* region were taken for comparison.

Results and Discussion

The indigenous varieties cultivated by farmers over decades, which are basically of Seedling origin and which are restricted to a particular region and termed as heirloom varieties were studied from four regions of India viz., *Amravati*, *Chittoor*, *Malihabad* and *Pusa*.

Indigenous Varieties of Amravati

The evaluation of the varieties showed that *Amravati Amba-6* recorded the maximum fruit weight (202.1 g), the minimum fruit weight was observed in the variety *Amravati Amba-5* (46.24 g). The TSS was observed to be maximum in the variety *Amravati Amba-7* (20.24°Brix), the minimum TSS was observed in the variety *Amravati Amba-12* (14.2°Brix). The pulp recovery was observed to be maximum in the variety *Amravati Amba-12*, which recorded 75.85%. All the selected elite varieties recorded more than 28.7% pulp recovery.

Indigenous Varieties of Chittoor

The evaluation of the varieties showed that *Baitpalli V. Ranga Reddy Naati 1* recorded the maximum fruit weight (530.7 g), the minimum fruit weight was observed in the variety *P. Reddyvaripalle K. Rajasekara Reddy Naati 2* (114 g). The TSS was observed to be maximum in the variety *P. Reddyvaripalle V. Ramamurthy Reddy Naati 2* (21° Brix). The pulp recovery was observed to be maximum in the variety *Talapulapalle Sreeramulu Achari*

Naati 4, which recorded as 82%. All the selected elite varieties recorded more than 60% pulp recovery. Wide variation was observed for the total carotenoid content among the varieties. The total carotenoid content was found to be maximum in the variety *P. Reddyvaripalli V. Ramamoorthy Reddy Naati 3* (26.44 mg/100g), minimum was seen in the variety *Palamakulapalli K. Ravindranath Naati 4* (3.0 mg/100g).

Indigenous Varieties of Malihabad

The evaluation of the varieties showed that *Goal Bhadaiya* recorded the maximum fruit weight (945 g), the minimum fruit weight was observed in the variety *Johri Safeda* (85 g). The TSS was observed to be maximum in the variety *Nisar Pasand* (25°Brix) and minimum was observed in the *Baramasi Malihabad* (11.44°Brix). The pulp recovery was observed to be maximum in the variety *Mahesh Pasand*, which recorded 90.97%. All the selected elite varieties recorded more than 46.58% pulp recovery.

Indigenous Varieties of Pusa

The evaluation of the varieties showed that *Vinod Rai Jagdishpur Seedling Madhukpia* and *Pusa Mango 2* recorded the maximum fruit weight (510 g), the minimum fruit weight was observed in the variety *Durga Thakur Dhobgama Seedling* (22 g). The TSS was observed to be maximum in the variety *Sambhu Pd. Thakur Dhobgama Kishanbhog Seedling* (22.8°Brix), the minimum TSS was observed in the variety *Dinesh Pathak Maruabad Kishanbhog Seedling* (8.6°Brix). The pulp recovery was observed to be maximum in the variety *Gauri Shankar Jagdishpur Kishanbhog Seedling*, which recorded 83%. All the selected elite varieties recorded more than 43% pulp recovery.

Morphological, agronomical as well as biochemical parameters (Rick and Holle, 1990; Weber and Wricke, 1994 and Kraemmer et al., 1995) have been widely used in the evaluation of various crops. Exploitation of such traits increases our knowledge on the genetic variability and strongly facilitates breeding for wider geographic adaptability. The vast diversity in mango has given rise to several indigenous varieties. Similar to the study conducted here several workers have studied the morphological descriptions of mango from time to time (Burns and Prayag, 1921; Mukherjee, 1948; Naik and Gangolly, 1950; Singh and Singh, 1956; Gangolly et al., 1957; Rajan et al., 1999; Yeshitela and Nessel, 2003; Desai and Dhandar, 2000; Dinesh and Vasugi,

Table 1. Fruit characteristics of indigenous varieties of Chittoor

S.No.	Variety	F. wt. (g)	Fr. length (cm)	Fr. width (cm)	TSS (°Brix)	Stone wt. (g)	Pulp (%)
1	Talapulapalle Sreeramulu Achari Naati 4	419.55	9.97	8.50	18.37	37.38	82.86
2	Talapulapalle Sreeramulu Achari Naati 6	206.83	9.03	6.93	18.97	37.03	64.85
3	Talapulapalle Sreeramulu Achari Naati 8	82.82	5.77	5.27	18.10	23.35	55.45
4	Talapulapalle Babu Reddy Lalbaba	292.34	9.27	7.90	15.80	35.56	65.00
5	Talapulapalle Babu Reddy Dilpasand	296.69	11.17	7.70	18.80	42.68	71.08
6	Talapulapalle Babu Reddy Thorappadi Variant 2	674.41	14.33	9.50	18.73	46.98	79.56
7	Talapulapalle Babu Reddy Naati 2	576.93	14.00	9.27	19.87	53.04	76.74
8	Talapulapalle Babu Reddy BogamRangasani	393.58	10.33	7.77	21.37	51.11	74.07
9	Talapulapalle Babu Reddy Chittithooha	306.81	11.00	7.63	17.93	45.05	70.45
10	Talapulapalle Sreeramulu Pillai Naati 1	139.53	9.20	5.23	17.53	19.11	67.36
11	Talapulapalle Sreeramulu Pillai Naati 2	423.35	10.73	8.77	16.07	44.26	78.82
12	Kalepalle Rajendra Reddy Naati 2	218.00	8.13	6.90	18.87	24.72	68.65
13	Kalepalle Subramanyam Chetty Najoka	197.47	9.23	6.50	18.50	32.79	71.98
14	Kalepalli P. Govinda Chetty Naati 1	455.76	13.03	8.70	19.90	50.79	70.56
15	P. Reddyvaripalle K Rajasekara Reddy Naati 2	114.26	7.53	5.23	16.33	24.67	61.72
16	P. Reddyvaripalli V Ramamoorthy Reddy Naati 3	433.16	12.40	8.80	13.53	35.39	76.60
17	P. Reddyvaripalle V Ramamurthy Reddy Naati 2	256.42	8.33	7.20	21.00	39.92	70.21
18	Gandlapalle K Gurappa Chetty Naati Khader	217.33	8.67	6.50	18.80	33.60	70.40
19	Gandlapalle Sreeramulu Reddy Naati 3	321.29	9.53	7.67	18.20	35.50	69.22
20	Gandlepalle Sreeramulu Reddy Naati 4	441.89	13.13	8.10	19.63	32.81	82.77
21	Gandlapalle Sreeramulu Reddy Naati 5	157.68	10.60	5.80	18.93	23.56	69.10
22	Gandlapalle Sreeramulu Reddy Naati 1	144.57	7.60	6.33	15.53	41.90	38.65
23	Gandlapalle Sreeramulu Reddy Naati 2	178.23	10.00	5.83	13.90	27.18	69.69
24	Thumbavaripalle K. Subramanyam Reddy Naati 3	116.73	8.27	5.37	21.07	13.12	76.80
25	Thumbavaripalle Munirathnam Reddy Manoranjitham	262.21	9.13	7.87	24.90	41.35	61.14
26	Thumbaripalle Munirathnam Reddy Punasa	172.83	7.53	6.43	21.17	19.95	65.83
27	Thumbavaripalle K Subramanyam Reddy Naati 1	484.01	12.44	8.53	19.76	40.13	82.68
28	Thumbavaripalle K Subramanyam Reddy Naati 2	150.00	8.27	6.01	21.04	26.75	57.13
29	Thumbavaripalle K Subramanyam Reddy Naati 4	186.56	8.90	6.53	22.17	24.28	66.82
30	Palamakulapalle K Ravindranath Naati 1	422.50	10.00	9.10	13.03	54.67	71.13
31	Palamakulapalle K Ravindranath Naati 2	549.51	14.87	8.40	13.73	82.19	63.71
32	Palamakulapalle K Ravindranath Naati 3	274.19	8.25	7.85	18.05	43.72	70.96
33	Palamakulapalle K Ravindranath Green Baneshan	464.41	12.97	8.43	8.77	70.75	68.06
34	Baitpalle V Ranga Reddy Naati 1	541.20	12.13	9.10	15.07	42.47	77.26
35	Baitpalle V Ranga Reddy Naati 2	337.78	9.73	8.20	16.30	41.63	73.70
36	Baitpalle V Ranga Reddy Gadiyaram	441.81	12.23	8.03	13.53	58.25	74.47
37	Gudipalle K Surendra Reddy Naati 1	162.10	8.83	5.70	18.33	35.43	65.38
38	Gudipalle K Surendra Reddy Naati 2	360.83	10.97	8.30	19.10	45.36	68.77

Table 2. Fruit characteristics of indigenous varieties of Amravati

S.No.	Variety	Fr. wt. (g)	Fr. length (cm)	Fr. width (cm)	TSS (°Brix)	Stone wt. (g)	Pulp (%)
1	Amravati Amba - 1	145.3	7.82	6.18	17.4	28.9	60.2
2	Amravati Amba - 5	46.24	5.28	4.14	16.3	15.6	36.1
3	Amravati Amba - 6	202.1	11.8	6.55	15.78	32.5	64.2
4	Amravati Amba - 7	70.52	6.62	5	20.24	16.85	55.8
5	Amravati Amba - 8	94.22	7.2	5.22	16.5	26.4	44.2
6	Amravati Amba - 9	70.25	6.22	4.8	18.2	28.58	28.7
7	Amravati Amba - 10	118.4	7.35	6.15	17.2	28.3	46.4
8	Amravati Amba - 11	78.1	6.45	5.3	16.2	25.5	45.2
9	Amravati Amba - 12	58.2	5.12	4.3	14.2	15.58	75.85
10	Amravati Amba - 13	128.2	7.5	5.65	18.4	30	62.2
11	Amravati Amba - 15	85.2	6.85	4.9	19.2	18.2	62.6
12	Amravati Amba - 17	155.12	7.25	6.2	19.6	27.28	75.2

Table 3. Fruit characteristics of indigenous varieties of Pusa

S. No.	Variety	Fr. wt.(g)	Fr. length (cm)	Fr. width (cm)	TSS (°Brix)	Stone wt. (g)	Pulp (%)
1	Pusa mango 2	510.0	12.1	8.5	16.4	50.0	77.0
2	Pusa mango 3	250.0	9.0	6.9	18.2	31.0	71.2
3	Pusa mango 4	160.0	7.6	6.3	17.5	30.0	58.6
4	Pusa mango 5	306.0	11.2	7.2	15.6	45.0	68.4
5	Pusa mango 6	184.0	8.6	6.2	19.7	36.0	63.8
6	Pusa mango 7	120.0	6.7	5.6	21.3	44.0	43.0
7	Pusa mango 8	308.0	10.7	6.9	19.6	49.0	64.2
8	Pusa mango 9	168.0	9.4	6.2	12.8	24.0	68.9
9	Pusa mango 10	170.0	9.8	5.3	21.5	30.0	57.3
10	Pusa mango 12	150.0	7.3	6.2	17.1	30.0	58.0
11	Pusa mango 13	300.0	10.1	7.5	18.6	50.0	61.3
12	Pusa mango 14	300.0	11.4	6.9	17.4	40.0	74.2
13	Pusa mango 15	170.0	8.4	6.0	18.4	40.0	57.4
14	Pusa mango 16	240.0	9.7	6.6	17.5	40.0	70.0
15	Prashant Chandra Jagdishpur Sipia Seedling	218.0	11.2	6.4	15.4	53.0	56.2
16	Vinod Rai Jagdishpur Malda Seedling	170.0	8.4	6.0	18.4	40.0	57.4
17	Prashant Chandra Jagdishpur Sukulia	290.0	10.7	7.3	11.0	40.0	61.0
18	Vinod Rai Jagdishpur Malda Seedling Chapariya	179.0	8.6	6.6	19.0	41.0	50.5
19	Prashant Chandra Jagdishpur Malda Seedling	273.0	9.7	7.2	17.8	38.0	65.5
20	Vinod Rai Jagdishpur Bhemha Biju	149.0	7.7	5.9	16.5	38.0	46.7
21	Bipin Rai Jagdishpur Kishanbhog Biju	279.0	9.2	7.5	16.4	33.0	67.5
22	Vinod Rai Jagdishpur Alphonso Seedling	121.0	6.64	5.4	20.2	32.0	43.9
23	Surya Kant Mishra Dhobgama Seedling	250.0	9.1	6.9	16.7	41.0	61.3
24	Ram Rekha Thakur Dhobgama seedling	300.0	10.1	7.5	18.6	50.0	61.3
25	Kapildev Prasad Singh Rohua, Muzaffarpur Malda Seedling	270.0	9.8	7.2	12.0	33.0	68.4
26	Chandra Kant Jagdishpur Kishanbhog Seedling	210.0	8.2	6.5	18.0	37.0	60.4
27	Rajesh Kumar Harpur Pusa Seedling Lal Mohia	500.0	11.3	8.9	14.6	58.0	72.7
28	Durga Thakur Dhobgama Seedling	22.0	9.2	6.1	15.7	15.7	59.5
29	Kedar Rai Basuari Samastipur Sipia Seedling	230.0	11.0	6.1	13.9	36.0	62.4
30	Vinod Rai Jagdishpur Seedling Lal Mohia	130.0	6.7	5.8	14.8	24.0	59.2
31	Tribhuvan Thakur Malinagar Kerwa Seedling	280.0	11.5	6.7	15.8	35.0	71.8
32	Manoj Kumar Singh Rohua, Muzaffarpur Malda Seedling	240.0	8.9	7.1	14.2	36.0	66.4
33	Sambhu Pd. Thakur Dhobgama Kishanbhog Seedling	150.0	9.1	5.5	22.8	34.0	65.0
34	Ramji Mahto Mahmada Sipia Seedling	170.0	9.8	5.3	21.5	30.0	57.2
35	Rajesh Thakur Malinagar Sipia Seedling	150.0	7.3	6.2	17.1	30.0	58.0
36	Daya Nand Thakur Dhobgama Sipia Seedling	160.0	9.1	5.5	22.8	34.0	65.0
37	Ramji Mahto Mahmada Sipia Seedling	150.0	9.1	5.4	20.2	30.0	64.0
38	Ram Upek Thakur Malinagar Sipia Seedling	170.0	8.4	6.0	21.3	30.0	65.8
39	Vinod Rai Jagdishpur Seedling Chapahia	160.0	7.9	6.3	20.0	30.0	63.2
40	Vinod Rai Jagdishpur Sipia Seedling	320.0	11.6	7.5	17.3	35.0	66.5
41	Ram Shankar Thakur Dhobgama Kishanbhog Seedling	270.0	8.4	7.8	15.5	28.0	79.0
42	Vijay Kumar Chaudhry Mhamda Sipia Seedling	260.0	10.2	7.0	18.0	30.0	71.8
43	Vinod Rai Jagdishpur Seedling Lal Pari	167.0	8.0	6.3	17.3	40.0	52.4
44	Rajneshwar Thakur Dhobgama Bombay Seedling	240.0	9.7	6.6	17.5	40.0	70.0
45	Sanjay Thakur MalinagarKishanbhog Seedling	190.0	8.6	6.5	21.8	30.0	66.0
46	Prashant Chandra JagdishpurMalda Seedling	273.0	9.7	7.2	17.8	43.0	65.5
47	Alok Kumar JagdishpurSukul Seedling	290.0	11.0	6.7	12.5	38.0	75.0
48	Chandrakant Rai Jagdishpur Unknown Seedling	402.0	11.8	7.6	16.6	44.0	75.5
49	Chandrakant Rai Jagdishpur Unknown Seedling Kishanbhog Seedling	180.0	9.0	6.1	17.8	33.0	64.3
50	Sambhu Pd Thakur Dhobgama Kishanbhog Seedling Sipia Seedling	270.0	9.8	6.9	17.7	31.0	74.2
51	Prashant Chandra Jagdishpur Sipia Seedling	190.0	9.2	6.4	17.0	30.0	66.6
52	Vinod Rai Jagdishpur Seedling Madhukpia	510.0	12.1	8.5	16.4	50.0	77.0
53	Gauri Shankar Jagdishpur Kishanbhog Seedling	450.0	11.8	8.3	16.4	34.0	83.0
54	Gaya Prasad Sharma Bhukul Malda Seedling	308.0	10.7	6.9	19.6	49.0	64.2
55	Murlidhar Sharma Shahjadpur, Kanti, Muzaffarpur Zarda Seedling	281.0	9.8	7.4	16.6	50.0	60.2
56	Md Abu Jaffar Rampur, Samastipur Jarda Seedling	180.0	8.6	6.3	16.3	27.0	66.0

Contd.

Table 3 Contd.

S. No.	Variety	Fr. wt.(g)	Fr. length (cm)	Fr. width (cm)	TSS (°Brix)	Stone wt. (g)	Pulp (%)
57	Raghupati Pd.Singh Mahmada Malda Selection	168.0	9.4	6.2	12.8	24.0	68.9
58	Ramakant Singh Rampur Bombai Green Seedling	247.0	8.9	6.3	20.6	27.0	66.0
59	Chandeshwar Pd. Singh Sukul Seedling	243.0	11.3	6.6	15.7	43.0	71.4
60	Kailash Pd. Rai Jagdishpur Malda Seedling	184.0	8.6	6.2	17.7	36.0	63.8
61	Dinesh Pathak Maruabad Kishanbhog Seedling	244.0	8.6	7.4	8.6	35.0	70.4
62	Satish Pathak Maruabad Sinduria Seedling	148.0	8.1	5.8	13.8	31.0	48.1
63	Nagendra Pd. Mishara Maruabad Kishanbhog Seedling	107.0	6.6	5.7	15.0	32.0	47.4
64	Parmanand Chaudhary Maruabad Dashahri Seedling	227.0	10.4	6.2	14.7	37.0	59.9
65	Bhikhari Singh Rampur Teknari Kishanbhog Seedling	256.0	9.1	7.7	13.4	56.0	58.6
66	Devendra Singh Rampur Teknari Zarda Seedling	169.0	8.3	6.1	14.6	29.0	63.1
67	Upender Thakur Bhuskaul Sinduria Seedling	306.0	11.2	7.2	15.6	45.0	68.4
68	Chandeshwar Pd. Singh Paterha Buzurg Dashahri Seedling	287.0	12.3	6.3	16.7	16.7	62.5
69	Chulbul Shahbajpur Kishanbhog Seedling	197.0	9.0	6.4	13.2	13.2	49.9
70	Upender Pandey Katarmala Zarda Seedling	365.0	10.8	8.4	16.5	51.0	69.4

Table 4. Fruit characteristics of indigenous varieties of Malihabad

S. No	Name	Fr. wt.(g)	Fr. length (cm)	Fr. width (cm)	TSS (°Brix)	Stone wt. (g)	Pulp (%)
1	Ahan Pasand	193.50	10.40	5.60	17.00	30.00	84.50
2	Alif Laila	247.00	11.00	6.73	21.55	31.25	69.98
3	Allahabadi Chausa	276.50	11.75	6.75	17.00	35.00	68.90
4	AmanAngoori	405.00	10.58	8.60	19.80	24.50	78.14
5	Aman Ibrahimpur	196.00	9.20	6.80	21.00	16.80	70.99
6	Amim Musaidabad	139.00	10.20	5.00	18.20	16.00	88.49
7	Amin	247.00	11.35	6.65	20.33	37.00	61.40
8	Aamin Abbasi	99.50	7.85	4.60	12.80	15.00	65.85
9	Aamin Abdul Ahad Khan	357.40	12.26	7.52	18.60	41.00	72.58
10	Aamin Tehsil	313.80	11.78	7.26	20.12	34.25	72.69
11	Aman Khurd	156.00	9.96	5.96	21.40	22.12	64.64
12	Amin (MTN)	212.00	10.20	6.10	18.20	42.00	63.21
13	Amin Dofasla	446.00	12.97	8.57	16.20	56.00	72.53
14	Amin Mohammad Yunus Khan	119.75	6.70	6.10	21.20	32.25	53.53
15	Amin Prince	315.20	12.12	7.04	19.80	32.40	73.28
16	Amit Deshi 2	97.50	6.80	4.70	16.69	27.00	72.31
17	Amrita	157.50	8.70	6.00	18.00	27.00	82.86
18	Amrita Pasand	116.25	7.70	5.00	18.00	23.40	79.87
19	Anil Pasand	175.75	9.40	6.00	18.25	43.00	75.53
20	Aslam Pasand	88.00	7.00	4.50	18.00	26.20	70.23
21	Baramasi Malihabad	154.00	10.32	5.60	11.44	26.48	62.83
22	Benazir	268.40	11.90	6.86	18.20	33.02	70.46
23	Benazir Sandilla	197.40	9.74	6.02	17.60	20.40	71.91
24	Bhadaila	370.33	9.80	8.03	18.70	46.00	76.15
25	Bhagwanta	193.20	9.34	6.84	20.00	44.00	56.94
26	Darbare Kalan	276.20	11.86	7.42	19.88	25.60	72.67
27	Dashehari (Improved)	297.00	12.40	6.80	20.20	32.00	68.35
28	Deshi (Karhile)	224.80	10.06	6.46	16.00	30.00	68.86
29	Deshi (Suresh)	352.00	12.73	7.50	20.00	36.00	69.89
30	Deshi Ram Kela	153.66	7.20	6.10	19.20	31.67	61.33
31	Deshi Chausa (Dina)	176.75	9.28	5.88	22.30	25.00	67.75
32	Deshi Chausa (Kanhaiya Lal, SAR)	128.00	9.40	4.95	22.00	26.00	60.94
33	Deshi Chausa (Karunesh, GM)	196.75	10.65	6.40	18.00	11.50	78.65
34	Deshi Gola	267.50	9.05	7.55	20.00	26.00	78.21
35	Deshi Gola SG	108.00	7.00	5.30	16.00	22.00	79.63
36	Deshi Lambui (Chhote Lal)	152.20	9.42	5.68	21.00	46.00	46.58
37	Deshi Lambui (Jagganath)	198.25	9.70	5.98	23.00	35.00	53.95
38	Deshi Naresh	117.50	7.60	4.70	17.40	17.00	85.53

Contd.

Table 4 Contd.

S. No	Name	Fr. wt.(g)	Fr. length (cm)	Fr. width (cm)	TSS (°Brix)	Stone wt. (g)	Pulp (%)
39	Deshi Radhey	126.50	9.20	5.00	24.00	26.00	79.45
40	Deshi Safeda	176.50	9.50	7.00	18.00	35.00	54.67
41	Deshi Safeda K2	185.00	9.50	5.80	18.40	24.00	87.03
42	Deshi T.B.	143.50	8.30	4.90	19.00	24.00	83.28
43	Desi Chausa G	185.50	10.00	6.20	18.32	25.00	86.52
44	Dudhiya Gola	317.75	10.58	7.58	20.00	42.00	66.33
45	Dudhiya Safeda N	280.67	11.60	7.00	18.00	53.00	81.12
46	Gilas	108.33	6.10	5.43	21.00	25.00	56.62
47	Goal Bhadaiya	945.00	14.20	10.40	18.00	55.00	77.78
48	Gola	195.00	9.65	6.10	18.60	22.50	72.05
49	Gola (Sarsanda)	111.00	7.00	6.60	19.00	35.00	68.47
50	Gulab Jamun	187.75	8.32	6.57	18.20	25.00	68.65
51	Hardil Aziz	253.00	9.50	7.72	18.40	30.50	69.51
52	Heere Hayat	174.33	9.33	6.03	18.00	45.00	48.37
53	Hushnara	183.00	10.85	5.90	16.30	36.50	65.03
54	Jalal Pasand	187.50	11.30	5.30	19.00	30.40	83.79
55	Jamun	235.33	10.73	6.67	19.23	30.00	63.63
56	Jauhari	104.00	7.48	4.98	20.00	21.00	63.46
57	Johri Safeda	85.00	7.20	4.70	22.12	14.67	63.00
58	Kachcha Meetha Gola	355.00	10.75	7.45	21.00	26.00	75.21
59	Kaliya Gola	99.00	6.38	5.46	19.00	15.00	63.64
60	Karwa Sagar	309.80	10.82	7.52	17.48	34.60	72.57
61	Khasulkhas	256.00	9.25	7.00	21.00	25.00	73.83
62	Khurd Amin	152.00	8.40	6.00	20.65	30.00	80.26
63	Kiran B	171.50	10.00	5.60	16.35	30.00	82.51
64	Kism	270.00	10.07	7.00	19.00	45.00	72.47
65	Kism (OriLal)	291.50	12.33	6.83	16.00	34.00	75.99
66	Kism Safeda	177.00	10.70	5.00	20.25	36.00	79.66
67	Krishana 2	164.00	9.40	5.60	20.00	32.00	80.49
68	Lakhnawwa Safeda	153.00	8.54	5.00	18.56	33.32	63.31
69	Lambauri	182.00	12.60	5.70	19.25	25.00	86.26
70	Lambi Amin	145.33	11.00	5.80	18.56	22.36	84.61
71	Lambori	184.67	10.03	5.97	24.00	30.00	64.26
72	Laumbauri Safeda	324.00	12.60	6.70	19.00	42.00	87.04
73	Madhurima	425.00	12.27	7.83	17.00	47.00	71.29
74	Mahesh Pasand	155.00	9.90	5.40	17.20	14.00	90.97
75	Makhan	175.00	9.20	5.30	21.80	32.40	65.87
76	Markeara	186.20	8.12	6.84	23.10	43.00	59.29
77	Matka Gola	322.50	10.45	7.90	19.40	35.00	70.54
78	Munjjar Aamin	645.00	16.50	8.50	18.20	65.00	75.97
79	Muzzar Amin	645.00	16.50	8.50	18.20	65.00	75.97
80	Nawaab Pasand	584.00	16.00	8.00	18.32	64.00	89.04
81	Nayab	158.20	9.06	5.78	21.00	28.20	63.55
82	Nazir Pasand	465.00	12.15	8.40	18.60	35.00	79.81
83	Nisar Pasand	273.00	11.80	7.08	25.00	32.20	70.59
84	Paan	354.00	10.50	8.60	19.56	36.00	89.83
85	Phool Pasant	171.50	11.50	5.30	18.35	36.00	79.01
86	Poon N-H	303.50	10.30	8.30	18.00	40.00	86.82
87	Priti Pasant	222.50	11.20	5.60	18.00	44.00	80.22
88	Raja Pasand	160.75	10.10	5.85	19.50	25.00	84.45
89	Rajrani	226.67	10.23	6.10	20.00	44.00	65.15
90	Rani Gola	367.00	11.40	8.30	18.00	50.00	86.38
91	Rani Pasand	280.00	10.10	6.80	19.00	42.00	85.00
92	Sadafar	210.67	8.87	6.33	17.00	40.00	65.82
93	Sadafar Mithulal	211.00	8.75	6.75	19.60	41.00	57.58
94	Sadaphal Malihabad	214.25	9.30	6.57	22.50	38.00	65.37
95	Safeda Amin	181.67	11.67	5.47	20.30	36.00	58.41
96	Safeda D	176.50	9.70	5.70	17.25	47.00	73.37
97	Safeda Daun	207.50	11.15	5.85	23.20	35.00	65.30

Contd.

Table 4 Contd.

S. No	Name	Fr. wt.(g)	Fr. length (cm)	Fr. width (cm)	TSS (° Brix)	Stone wt. (g)	Pulp (%)
98	Safeda Deshi	172.50	9.60	6.00	18.25	44.00	74.49
99	Sanjay Pasand	328.00	12.00	7.20	19.32	34.00	89.63
100	Sawanha	162.50	9.65	6.00	19.00	31.00	62.15
101	Serehayat	264.50	11.15	7.00	22.30	37.50	68.86
102	Sheredar	461.80	10.88	7.70	19.40	38.62	78.57
103	Shobha	118.67	8.30	4.70	19.00	26.00	78.09
104	ShorabSah	243.00	11.90	6.70	19.00	28.50	69.90
105	Shweta	373.00	12.15	7.05	20.66	31.00	77.75
106	Surkha Burma	221.60	10.18	6.40	22.00	42.20	64.03
107	Surkha Gola M	173.00	10.30	5.80	18.00	43.00	75.14
108	Surya Amim	184.00	9.30	6.20	22.52	43.00	76.63
109	Surkha Jafarbagh	146.40	7.52	5.86	20.12	23.80	65.95
110	Taimuria	198.50	12.25	5.75	21.00	18.00	70.53
111	Tukmi Heera	214.00	9.76	6.30	19.00	35.00	71.50
112	Tukmi Lamba	196.00	10.50	5.70	18.20	27.00	86.22
113	Vilasita	178.00	9.40	5.50	21.00	36.00	79.78
114	Zafrani Shahabad	280.40	11.72	6.84	20.67	36.00	70.12
115	Zardalu (Seedling)	171.33	10.27	5.83	18.20	38.50	61.48

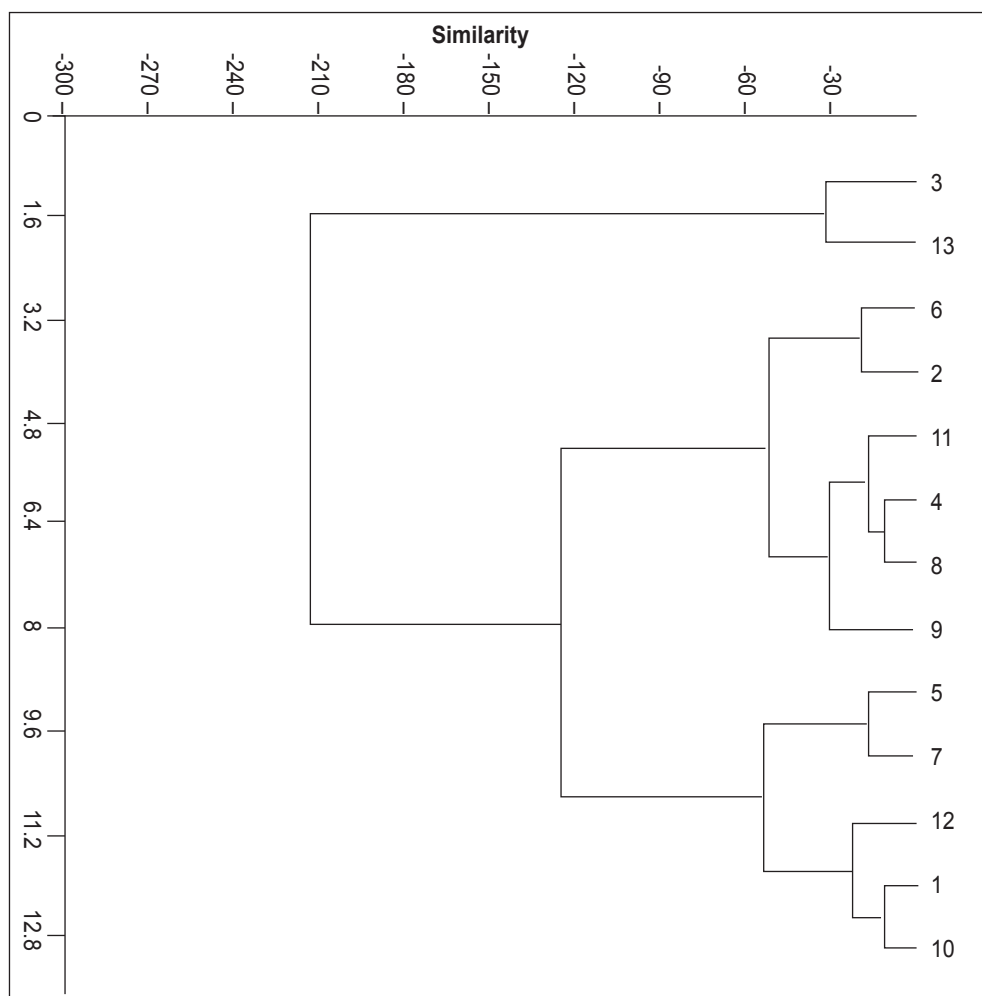


Fig. 1. 1. AmravatiAmba-1, 2. Amravati Amba-5, 3. Amravati Amba-6, 4. AmravatiAmba-7, 5. Amravati Amba-8, 6. Amravati Amba-9, 7. Amravati Amba-10, 8. Amravati Amba-11, 9. Amravati Amba-12, 10. AmravatiAmba-13, 11. Amravati Amba-15, 12. Amravati Amba-17, 13. Alphonso.

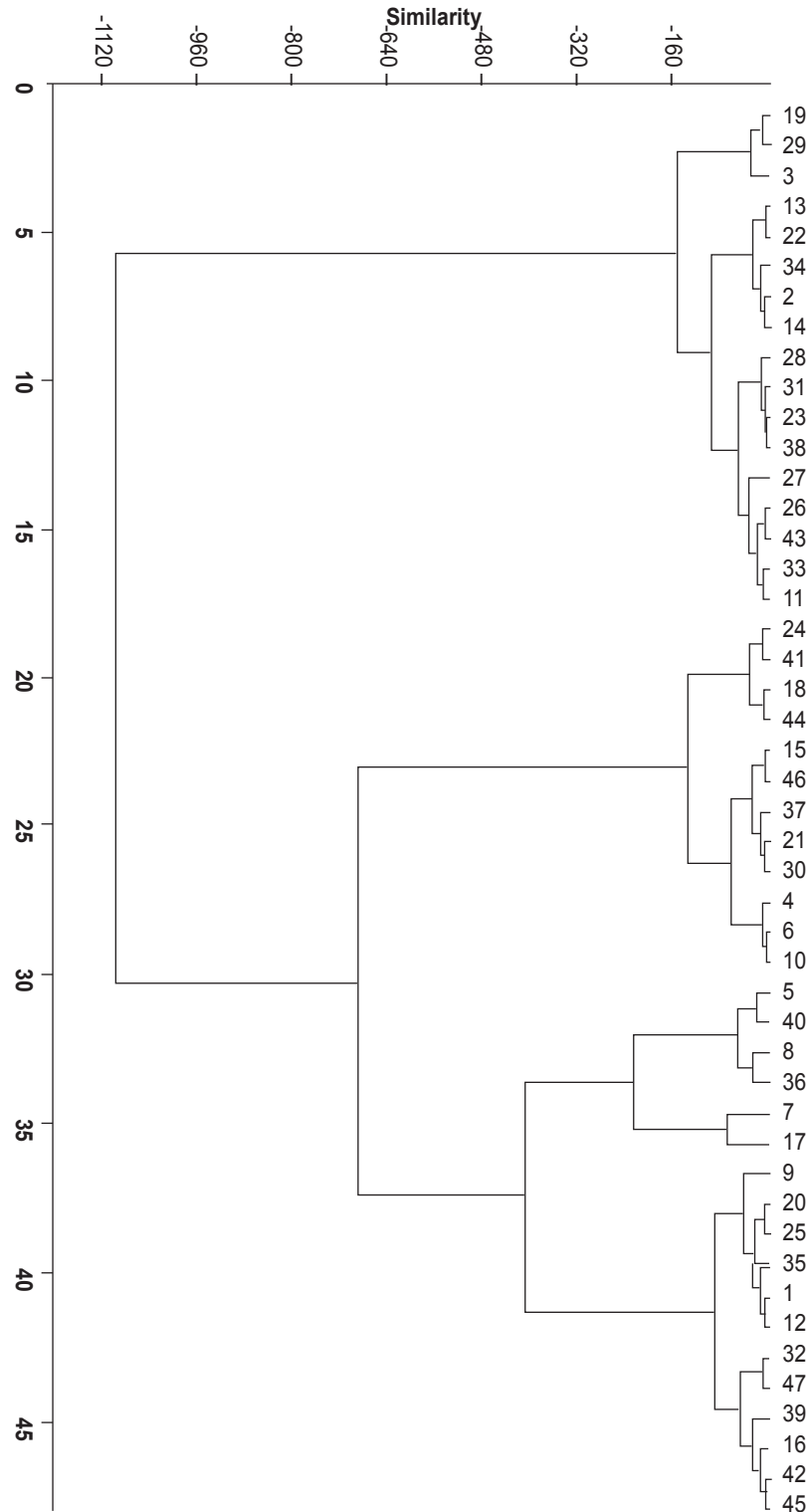


Fig. 2. 1. TSAN4, 2. TSAN6, 3. TSAN 8, 4. TBRLB, 5. TBRN1, 6. TBRD, 7. TBRT, 8. TBRN 2, 9. TBRBR, 10. TBRC, 11. TSPN1, 12. TSPN2, 13. KRRN2, 14. KSCN, 15. KPSN1, 16. KGCN1, 17. KRRN3, 18. RKRRN1, 19. RKRRN2, 20. RVRN 3, 21. RVRN2, 22. GGNK, 23. GPJN 2, 24. GSRN3, 25. GSRN4, 26. GSRRN5, 27. GSRRN1, 28. GSRRN2, 29. THKS 3, 30. THMRM, 31. THMRP, 32. THKSRN1, 33. THKSRN2, 34. THKSRN4, 35. PKRN1, 36. PKRN2, 37. PKRN3, 38. PKRN4, 39. PKRNGB, 40. BVRRN1, 41. BVRRN2, 42. BVRRG, 43. GKSRN1, 44. GKSRN2, 45. Banganpalli, 46. Alphonso, 47. Totapuri

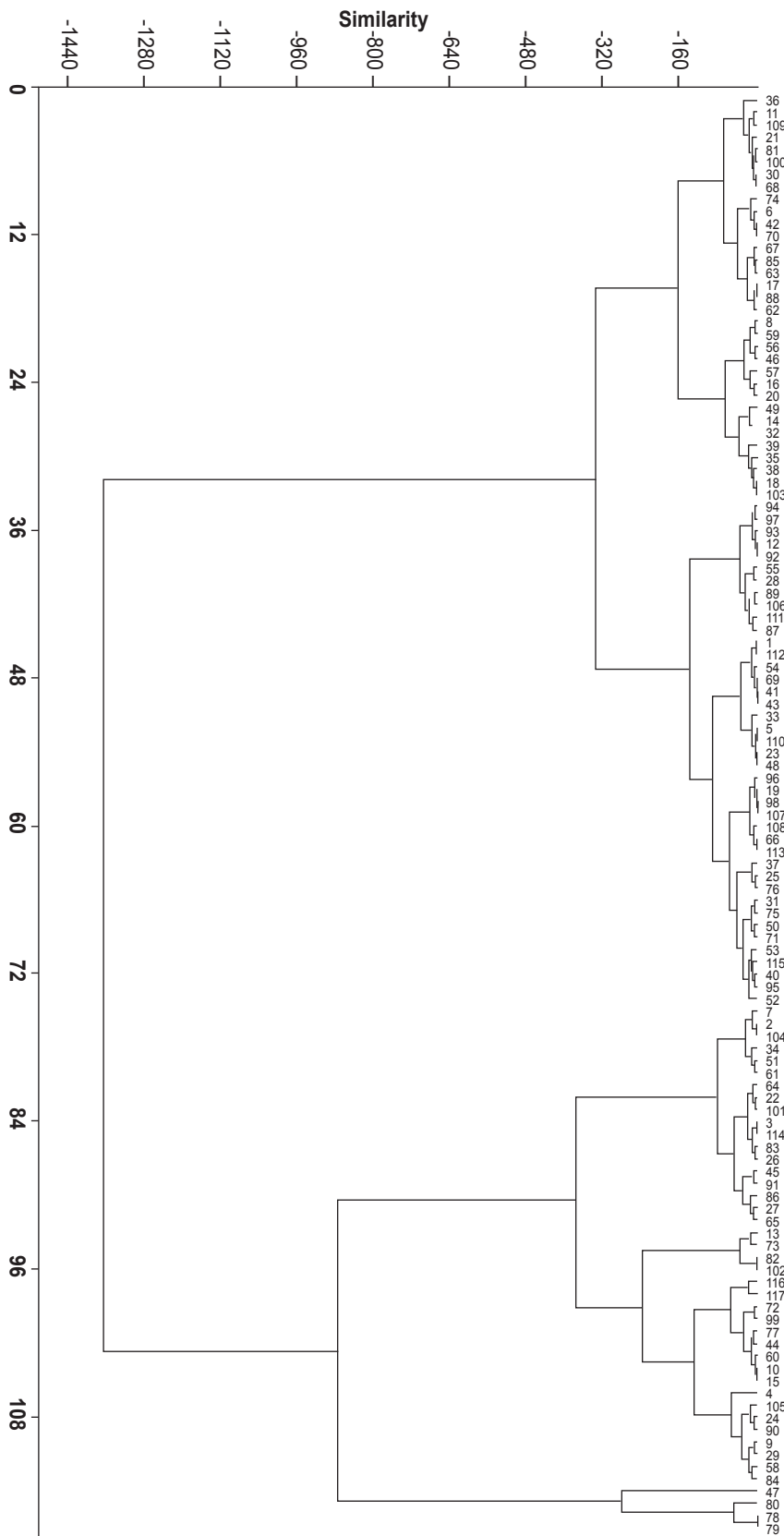
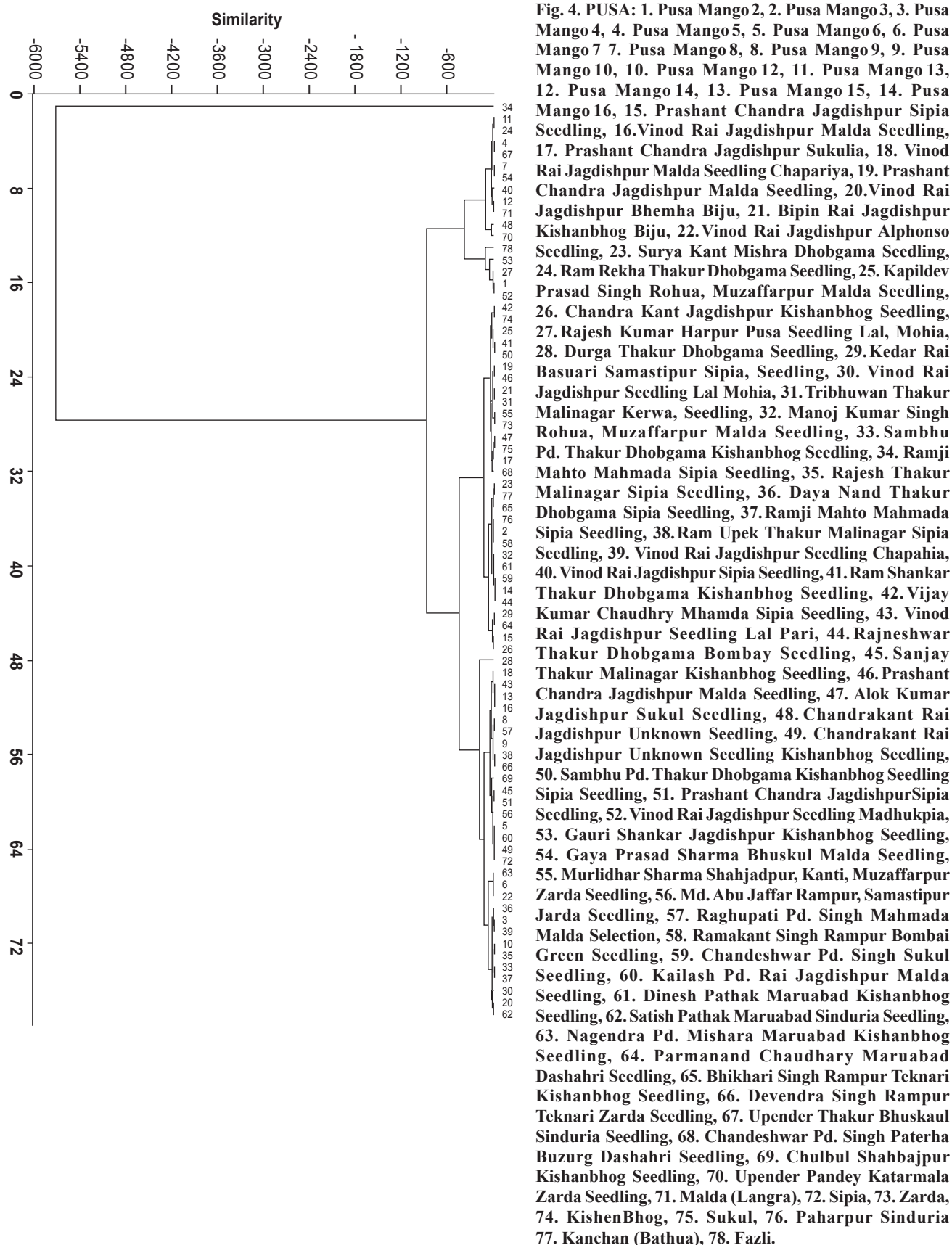


Fig. 3. MALIHABAD: 1.Ahan Pasand, 2. Alif Laila, 3. Allahabadi, Chausa 4.Aman Angoori, 5.Aman Ibrahimpur, 6.Amim Musaidabad, 7.Amin, 8.Aamin Abbasi, 9.Aamin Abdul Ahad Khan, 10.Aamin Tehsil, 11.Aman Khurd, 12.Amin (MTN), 13.Amin Dofasla, 14.Amin Mohammad Yunus Khan, 15.Amin Prince, 16.Amit Deshi 2, 17.Amrita, 18.Amrita Pasand, 19.Anil Pasand, 20.Asram Pasand, 21.Baramasi Malihabad, 22. Benazir, 23. Benazir Sandilla, 24.Bhadaila, 25.Bhagwanta, 26. Darbare Kalan, 27. Dashehari (Improved), 28.Deshi (Karhile), 29. Deshi (Suresh), 30.Deshi Ram Kela, 31.Deshi Chausa (Dina), 32. Deshi Chausa (Kanhaiya Lal, SAR), 33.Deshi Chausa (Karunesh, GM), 34.Deshi Gola, 35. Deshi Gola SG, 36. Deshi Lambui (Chhote Lal), 37. Deshi Lambui (Jagganath), 38. Deshi Naresh, 39. Deshi Radhey, 40. Deshi Safeda, 41. Deshi Safeda K2, 42. Deshi T.B., 43. Desi Chausa G, 44. Dudhiya Gola, 45. Dudhiya Safeda N, 46. Gilas, 47. Goal Bhadaiya, 48. Gola, 49. Gola (Sarsanda), 50. Gulab Jamun, 51. Hardil Aziz, 52. Heere Hayat, 53. Hushnara, 54. Jalal Pasand, 55. Jamun, 56. Jauhari, 57. Johri Safeda, 58. Kachcha Meetha Gola, 59. Kaliya Gola, 60. Karwa Sagar, 61. Khasulkhas, 62. Khurd Amin, 63. Iran B, 64. Kism, 65. Kism (Ori Lal), 66. Kism Safeda, 67. Krishana 2, 68. Lakhnawwa Safeda, 69. Lambauri, 70. Lambi Amin, 71. Lambori, 72. Laumbauri Safeda, 73. Madhurima, 74. Mahesh Pasand 75. Makhan, 76. Markeera, 77. Matka Gola, 78. Munjjar Aamin, 79. Muzzar Amin, 80. Nawaab Pasand, 81. Nayab, 82. Nazir Pasand, 83. Nisar Pasand, 84. Paan, 85. Phool Pasand, 86. Poon N-H, 87. Priti Pasand, 88. Raja Pasand, 89. Rajrani, 90. Rani Gola, 91. Rani Pasand, 92. Sadafar, 93. Sadafer Mithulal, 94. Sadaphal Malihabad, 95. Safeda Amin, 96. Safeda, 97. Safeda Daun, 98. Safeda Deshi, 99. Anjay Pasand, 100. Swanha, 101. Seehayat, 102. Sheedar, 103. Shoba, 104. Shora Sah, 105. Shweta, 106. Surkha Burma, 107. Surkha Gola M, 108. Surya Amim, 109. Surkha Jafarbagh, 110. Taimuria, 111. Tukmi Heera, 112. Tukmi Lamba, 113. Vilasita, 114. Zafarani Shahabad, 115. Zardalu (Seedling), 116. Dashehari, 117. Langra.



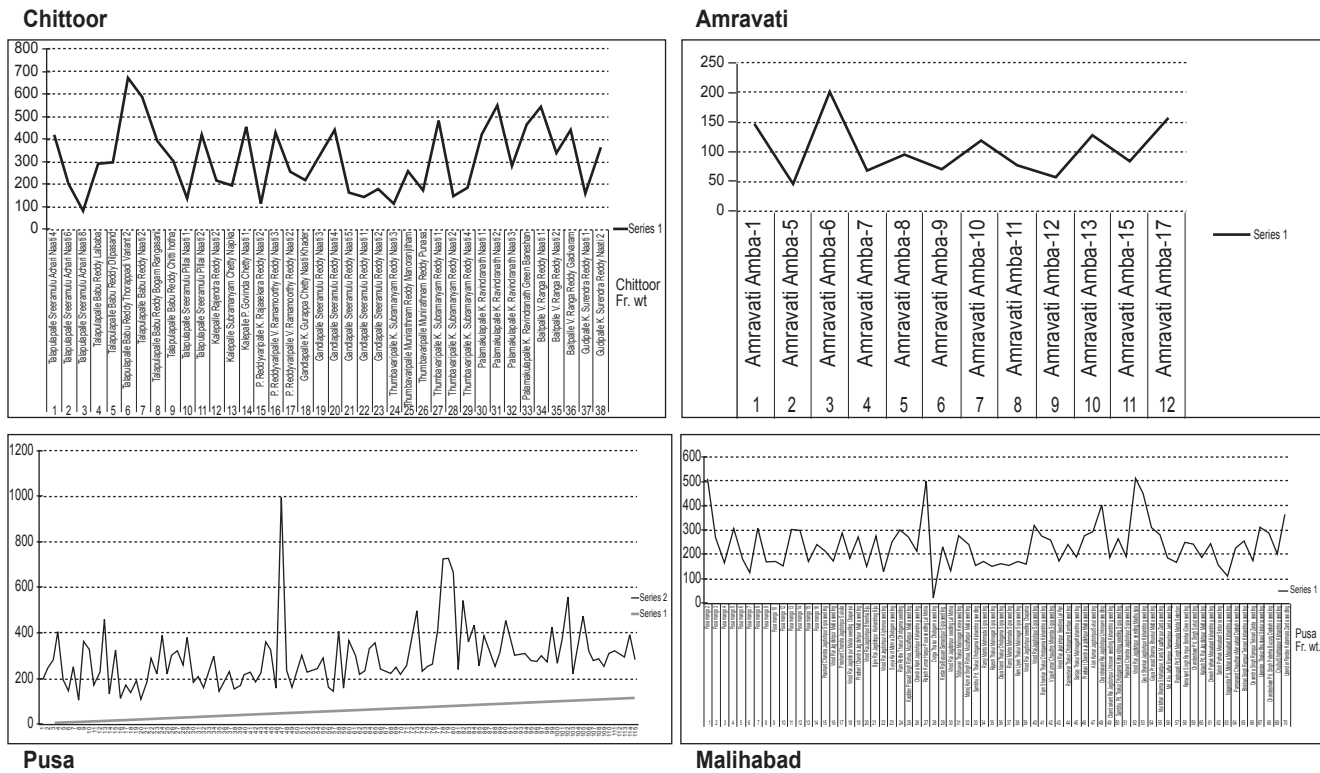


Fig. 5. Fruit weight pattern in different sites

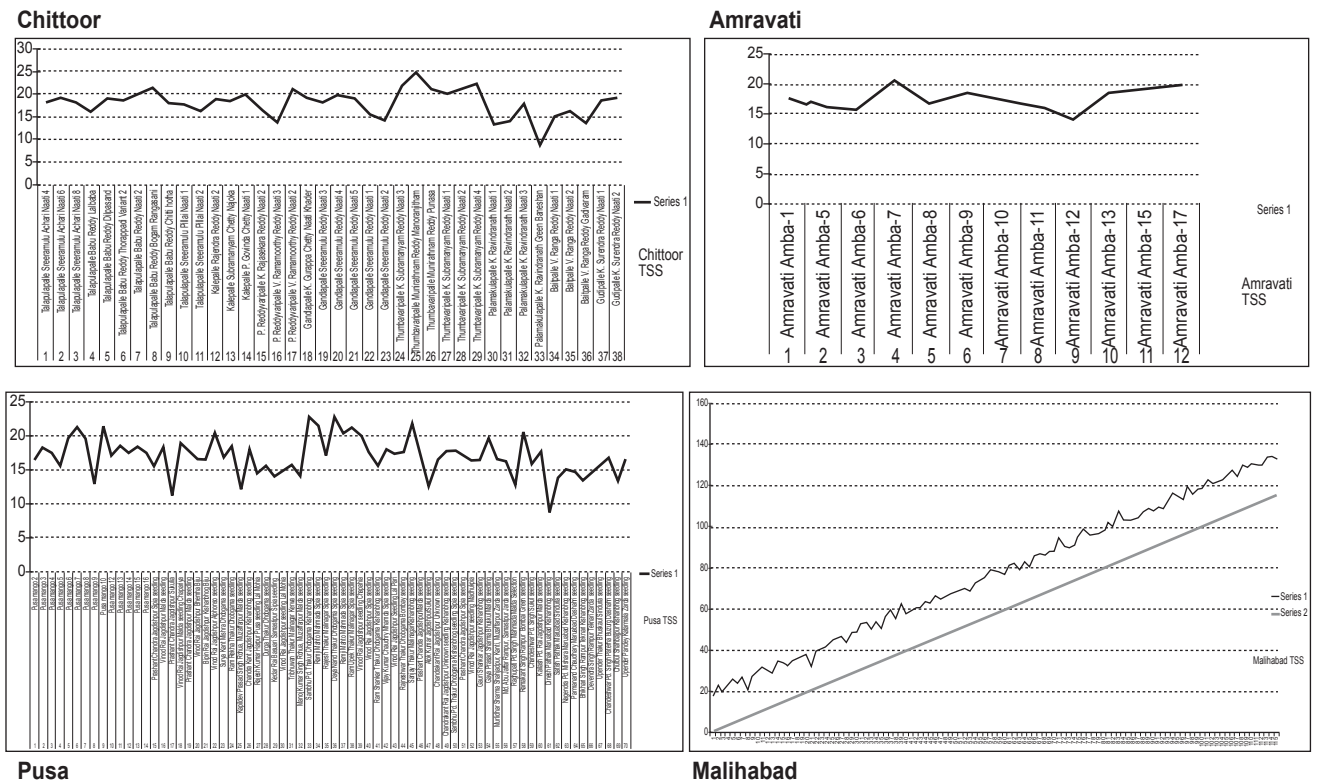


Fig. 6. TSS pattern in different sites

2002). Yadav and Singh (1985) opined that South and North Indian varieties belong to two different ecotypes of *M. indica* based on physiology of flowering. In such situations diversity analysis based on morphological characters are likely to show inconsistencies. The inter site comparison of various heirloom varieties for important traits viz., fruit weight, TSS and pulp percentage showed variation between the sites (Fig. 5 to 7). With regard to fruit weight, the variability present in the diversity rich regions of *Malihabad* and *Pusa* is very high, whereas in *Amravati* the variability is less for this trait. The characteristics TSS follow the same pattern but in the case of *Malihabad* there is clear-cut gradation starting from low to high. The pulp recovery expressed as percentage is observed to be similar in all the four sites. Ravishankar *et al* (2000), studied the genetic diversity in eighteen commercial varieties of mango grown in India using RAPD analysis, they observed two major groups; one consisting of northern, eastern and western varieties, another consisting of southern cultivars, their study also indicated that the variety *Kesar* from western region of India was associated with *Neelum* and *Rumani*. The cluster analysis was carried out using past software separately for each site along with the commercial cultivars to see their relationship. In the case of the *Amaravati* site, cluster was developed using the indigenous varieties of *Amaravati* and commercial variety *Alphonso*. Two main clusters were observed, in one of the clusters *Alphonso* and indigenous variety *Amba-6* were grouped together, which shows that this indigenous variety is similar to *Alphonso* and probably is a Seedling descent. The second cluster was divided into two-sub clusters containing 11 indigenous varieties of the same region. Vasugi *et al.* (2012) concluded that genotypes belonging to different geographic region might have evolved from the existing mango gene pool from which they were selected by local people to domesticate them indifferent areas for cultivation.

In the Chittoor site 2 main clusters were observed. In the 1st cluster, 17 Chittoor indigenous varieties were grouped together. The second cluster was sub divided into two sub clusters and this again is divided into 2 sub clusters where in one sub cluster has the varieties *Alphonso* and *KPSN1*. In the second sub cluster *Totapuri* and *THKSRN1*, *Banganpalli* and *BVRRG* are grouped together, which shows that these varieties are Seedlings derived from the present day commercial varieties.

The cluster diagram of *Malihabad* indicates two main

clusters. The 1st group represents only indigenous varieties and in the second group the cultivars *Dashehari*, *Langra* are grouped with *Laumbaori Safeda*, *Anjay Pasand*, *Matka Gola*, *Karwa Sagar*, *Dudhiya Gola*, *Aamin Tehsil* and *Amin Prince* in the 1st sub cluster. In the 2nd sub cluster remaining indigenous varieties are grouped together. Hence, selection of indigenous varieties from the pool of 1st sub-cluster may help in developing varieties or pre-breeding lines similar to *Langra* and *Dashehari*.

With regard to the clustering in the indigenous varieties of *Pusa*, first cluster contains only one indigenous *Ramji Mahto Mahmada*, *Sipia* seedling, which shows that this variety is distinctly different. The second cluster is subdivided into two sub clusters in which *Langra* and *Pusa Mango-12* are grouped together and in the second sub cluster remaining indigenous varieties grouped.

Heirloom varieties have been conserved and grown for various reasons. Perales *et al.* (2003a) opines that farmers play an important, role in the maintenance of crop genetic diversity, farmers do experiment with new plant materials and adopt them if they turn out to be superior to traditional varieties or landraces. This is so in the case of high-altitude region in Mexico where traditional varieties of maize are still grown in spite of the lack of marginality. In this region, local maize varieties are advantageous because they are higher-yielding, resist infestation by weevils better, and are more tolerant to drought and lodging than modern cultivars. This is similar to the Seedling originated mango varieties, which are being grown in spite of quality not very superior. However, farmers have varied uses for these varieties.

Heirloom Varieties, Characteristics and their Utility

The heirloom varieties are of Seedling origin and most of them are regular bearers. These are observed to be growing as individual plants in several orchards of the mango-growing farmers. They have great potentiality as several of them have desirable traits viz., keeping quality and high nutritive value for like *naati* variety P. Reddyvaripalli V. Ramamoorthy Reddy *Naati* 3 recorded high total carotenoids (26.44 mg/100g). Similar studies carried out by Dhandar and Desai (2000) resulted in the selection and isolation of *Cardozo Mankurd*. These Seedling selection can be registered as farmers' varieties, which would benefit the farmer by ensuring the rights. These varieties will be of immense value to a researcher as they can be used in the breeding programme, also they

can be used by the farmers for other value added products and due to their regularity in bearing help the farmer in getting better income when the commercial varieties are not in fruiting. Another important characteristic feature is the bearing season—in these Seedling types early season, mid-season and late season varieties are noticed.

Acknowledgements

UNEP-GEF/TFT Project “Conservation and Sustainable Use of Wild and Cultivated Tropical Fruit Tree Diversity” is gratefully acknowledged for the support.

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