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GENETIC VARIABILITY AMONG SEEDLING ORIGIN TREE POPULATION OF MANGO (*MANGIFERA* SPP.) IN HIMACHAL PRADESH, INDIA

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Abstract

A survey to the existing seedling origin tree population of wild *Mangifer*a spp. was carried out at Hamirpur and Kangra districts of Himachal Pradesh, India. Eighty one healthy and bearing tree population originated from seedlings in the region were marked. Wide range of genetic variability in qualitative and quantitative characters were observed for fruit, stone, peel, pulp and other fruit characters. Hamirpur district exhibited a variety in quality of fruits with varied fruit shape, colour, attractiveness etc. The significant variation was observed for different fruit parameters like fruit dimensions, fruit weight, fruit volume, stone weight, stone length, of stone, stone thickness, of stone, pulp weight, peel weight, per cent of edible and non-edible portions, ratio of stone weight to pulp weight, ratio of peel weight to pulp weight, skin thickness and TSS (Total Soluble Solids). The selected genotypes could be classified into different categories based upon their utility, *viz.*, pickle, sucking, table purposes etc.

Introduction

The mango is undoubtedly the most important fruit crop of India. It covers largest area compared to any other fruit in the country and thrives in almost all regions except at altitudes above 3000 feet and prefers frost-free dry climates (Gangolly *et al.* 1957). Mango has a long period of domestication in India resulting in high genetic variability. The majority of the commercial varieties of mango in India have originated as natural chance selections (Dey and Singh 2004). Mango being a highly cross-pollinated and heterozygous fruit crop exhibits wide genetic variability in seedling population. Majority of cultivated mango varieties were developed through selection on the basis of fruit shape, size, colour, time of maturity, juice, content, TSS/acid blend, flavour, aroma, taste, etc. Presently, India harbours more than 1000 mango varieties/land races in regions of different diversity and represents the biggest mango genepool of the world. In sub-mountane zone of Himalayan region, old mango plantation predominantly from seedling origin are established naturally or propagated through selected stones from meritorious indigenous mango plants on the basis of fruit quality characteristics by local fruit lover during 19th and early 20th century. These are at present mostly growing along a strip of roads, riverbanks, undulated terrain in mountainous tracts, government revenue lands, mango groves, etc., exhibit a wide range of variability in desirable horticultural traits like fruit shape, size, juice consistency, bearing regularity, fruit yield, tolerance/resistance to various biotic and abiotic stresses (Navprem *et al.* 2011). Keeping this insight variation in seedling tree population of mango was explored to assess their possibilities in future fruit crop improvement program.

Materials and Methods

Mango, having an andromonoecious floral structures encourages cross pollination. This enables a greater diversity within. Mango harbours more than 1000 registered varieties but potential of seedling origin trees is still unknown. As each seedling origin mango exhibits a unique

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feature the survey was undertaken to explore the existing variability in mango of seedling tree origin in Himachal Pradesh for utilization its potential in future breeding programs. The study was conducted covering entire seedling mango tree population existed in Hamirpur and Kangra districts of Himachal Pradesh, India. It was carried out on existing seedling tree population of mango, during 2013 - 15. The region opted for research particularly falls under sub-mountain zone which stretched from N 31^0 30' to N32^0 15' and E75^0 45 to 76^0 35' with elevation ranging from 551 - 2550 m. covering a ground distance of about 567 km which conceals entire seedling mango tree population existed. Out of total population 81 healthy and bearing seedling mango trees were subjected for selection. Fruits from each marked tree were subjected for detailed morpho-physicochemical evaluation. A total of 20 fruits were selected randomly from all directions from each individual tree and used for evaluation. The traits considered for evaluation were fruit dimension, fruit weight, fruit volume, stone weight, pulp weight, peel weight, stone/pulp ratio, edible and non-edible portion per cent, fruit shape, skin color, fruit blush, skin thickness, skin texture, pulp texture, adherence of skin to pulp, fiber content, beak type, sinus type and slope of shoulders. The morphological characterization was done adopting standard mango descriptors developed by the IPGRI (IPGRI 2006). The chemical analysis conducted by following standard protocols.

Results and Discussion

The fruit characters are almost exclusively reliable for identification, description and classification of mango varieties and germplasm. Visual characters like fruit shape, peel color etc. could be considered as basic indicative tools in identification of germplasm (Naik and Gangolly 1950, Singh and Singh 1956). Cumulative length and breadth of fruits ranged from 13.98 (MkH1) to 80.58 cm^2 (HmH3) with an average dimension of 28.24 cm^2. Coefficient of variation was recorded as 38.59 per cent. Average fruit weight among sampled fruits was 60.62 gram. There existed a wide variation in terms of fruit morphological characters. Mean weight of fruit ranged from 27.55 (MkH6) to 169.12 g (KgH1). Coefficient of variation was recorded as 47.57 per cent. Volume of fruit measured among sampled tree population revealed that average fruit volume was 65.57 ml which ranged from 31.50 ml (MkH1) to 178.83 ml (HmH3). Coefficient of variation was recorded as 43.32 per cent. Growth is an irreversible increase in fruit dimensions, fruit weight and volume of the fruit. Due to cell division (increase in number) and cell enlargement (increase in size) fruit weight increases day by day. Fresh weight is less useful because it fluctuates, depending on the moisture status of the fruit. The variation in fruit morphological characters of the different seedling mango trees noticed may be due to genetic or physiological factors. These observations are in agreement with the findings of Iyer *et al.* (1988), Haque *et al.* (1993), Chaudhari *et al.* (1997), Desai and Dhander (2000), Anila and Radha (2003), Kumar and Bramhachari (2004), Kundu *et al.* (2013). The studies at various locations across the globe on fruit morphological characters of mango concluded a common phenomenon that genetic or physiological factors govern this wide existing variation among them (Table 1 and Chart 1). Weight of stone ranged between 6.34 (MkH6) and 40.31 g (KgH1). The average weight of stone was 14.43 g with 46.59 per cent coefficient of variation. Length of stone varied from 17.78 mm (UpH5) to 71.47 mm (SiH2). Average length of stone was 35.78 mm with 35.77 per cent coefficient of variation. Width of stone ranged between 10.95 (MkH1) and 51.28 mm (SiH2). The average width of stone was 24.17 mm with 36.79 per cent coefficient of variation. Thickness of stone varied from 14.83 (UpH5) to 37.26 mm (HmH3) with an average of 21.31. Coefficient of variation was recorded as 18.90 per cent. Though shape of fruit is considered as a diagnostic character for description and identification of mango fruit, but stone characters could be taken up as secondary character in classification of mango (Singh and Singh 1956). There exist numerous

Table 1. Extent of variation in fruit characters of seedling origin mango tree **in Himachal Pradesh/.**

Sl. no.	Tree code	Fruit dimen-sions (cm^2)	Fruit weight (g)	Fruit volume (ml)	Stone weight (g)	Stone length (mm)	Stone width (mm)	Stone thickness (mm)	Pulp weight (g)	Peel weight (g)	Edible portion (%)	Non-edible portion (%)	Stone: pulp	Peel: Pulp	Skin thickness (mm)	TSS (°Brix)
1.	KaH1	15.33	32.33	35.67	8.47	19.70	17.61	16.00	16.35	7.51	49.4	50.60	0.560	0.539	0.93	11.52
2.	KaH2	15.10	34.80	35.00	7.16	18.80	14.89	15.41	20.15	7.48	56.56	43.44	0.428	0.417	0.88	8.85
3.	KaH3	31.55	66.53	71.33	15.58	39.34	31.14	23.32	36.07	14.87	52.47	47.53	0.519	0.498	1.66	9.64
4.	MkH1	13.98	33.05	31.50	7.21	17.81	10.95	15.02	19.68	6.16	57.39	42.61	0.425	0.368	1.05	10.84
5.	MkH2	24.56	47.46	54.67	11.61	31.08	19.84	20.50	23.64	12.21	49.24	50.76	0.514	0.545	1.34	11.71
6.	MkH3	26.50	52.22	58.83	12.55	33.11	21.63	21.28	27.38	12.30	52.27	47.73	0.467	0.459	1.54	11.38
7.	MkH4	18.61	38.88	42.50	9.25	23.48	15.65	17.33	20.78	8.84	52.84	47.16	0.468	0.451	1.18	8.82
8.	MkH5	19.04	38.09	43.33	9.17	23.75	15.88	17.51	20.03	8.89	52.33	47.67	0.468	0.456	1.10	9.37
9.	MkH6	14.68	27.55	33.83	6.34	19.02	16.41	15.55	14.04	7.17	50.90	49.10	0.468	0.547	0.95	10.72
10.	MkH7	23.55	55.13	53.50	11.63	29.96	19.33	19.83	32.14	11.37	58.10	41.90	0.369	0.366	1.31	12.58
11.	RsH1	39.59	114.54	76.67	27.70	36.81	27.73	24.73	60.40	26.45	52.19	47.81	0.477	0.468	2.53	13.66
12.	RsH2	30.64	62.95	68.50	15.39	38.20	26.24	24.75	33.26	14.30	52.80	47.20	0.464	0.431	2.00	12.52
13.	RsH3	28.00	54.34	61.83	14.26	35.10	23.74	20.45	27.47	12.61	50.29	49.71	0.534	0.472	1.65	11.00
14.	RiH1	26.77	67.48	137.50	16.15	41.19	29.07	22.39	36.09	15.24	53.44	46.56	0.451	0.423	1.79	12.26
15.	RiH2	20.47	40.94	46.83	10.41	25.64	17.28	18.31	20.84	9.69	50.69	49.31	0.510	0.477	1.36	10.63
16.	RiH3	17.12	34.24	38.33	8.37	21.46	14.49	16.63	17.80	8.06	51.71	48.29	0.482	0.465	1.05	12.18
17.	LgH1	21.42	42.83	47.17	10.27	27.11	18.20	18.95	22.51	10.05	52.57	47.43	0.457	0.448	1.21	12.63
18.	LgH2	24.77	49.54	55.33	12.09	31.25	20.36	20.22	26.20	11.26	52.70	47.3	0.471	0.442	1.38	14.05
19.	LgH3	35.90	77.78	79.83	18.31	44.08	31.52	24.11	42.66	16.81	54.72	45.28	0.436	0.401	1.93	12.77
20.	HaH1	53.06	106.12	118.33	25.45	62.71	43.04	31.16	56.23	24.44	52.98	47.02	0.458	0.438	2.96	14.52
21.	HaH2	29.54	59.08	65.00	14.17	37.24	24.59	22.52	31.25	13.66	52.82	47.18	0.458	0.442	1.92	12.87
22.	SiH1	35.40	123.43	160.83	27.16	69.77	42.91	24.41	69.23	27.03	55.44	44.56	0.420	0.411	2.96	11.15
23.	SiH2	49.85	163.03	108.67	38.13	71.47	51.28	28.83	105.23	19.67	64.56	35.44	0.364	0.190	2.61	14.24
24.	SiH3	19.28	38.56	44.17	9.08	24.61	15.93	18.00	20.52	8.95	53.28	46.72	0.444	0.436	1.30	10.45
25.	GsH1	22.01	44.03	48.5	10.98	27.78	18.41	19.18	22.63	10.42	51.36	48.64	0.487	0.464	1.24	11.81
26.	GsH2	28.56	60.46	64.17	14.35	35.39	24.88	21.47	33.00	13.12	54.45	45.55	0.439	0.402	1.58	11.32
27.	GsH3	31.37	64.42	70.00	15.16	39.15	27.15	22.87	34.59	14.67	53.66	46.34	0.439	0.426	1.78	12.47
28.	UpH1	15.95	31.9	36.67	7.53	20.28	13.07	15.99	17.10	7.27	53.54	46.46	0.444	0.429	1.10	8.77
29.	UpH2	24.57	52.46	54.50	12.17	30.12	21.80	19.53	28.81	11.48	54.79	45.21	0.426	0.405	1.30	10.74
30.	UpH3	15.00	31.18	34.17	7.53	18.76	13.32	15.13	16.78	6.87	53.78	46.22	0.450	0.411	0.99	8.77

(Contd.)

Sl. no.	Tree code	Fruit dimen-sions (cm^2)	Fruit weight (g)	Fruit volume (ml)	Stone weight (g)	Stone length (mm)	Stone width (mm)	Stone thickness (mm)	Pulp weight (g)	Peel weight (g)	Edible portion (%)	Non-edible portion (%)	Stone: pulp	Peel: Pulp	Skin thickness (mm)	TSS (ºBrix)
31.	UpH4	17.37	34.74	40.00	8.23	21.94	14.66	16.85	18.27	8.23	52.52	47.48	0.456	0.455	0.99	8.71
32.	UpH5	14.03	28.07	31.67	6.59	17.78	11.74	14.83	14.92	6.56	53.13	46.87	0.445	0.444	0.86	9.11
33.	JsH1	35.34	72.34	78.83	17.63	44.09	29.53	24.60	38.52	16.19	53.17	46.83	0.462	0.424	1.80	11.89
34.	JsH2	44.86	91.39	100.00	21.52	56.35	39.98	27.85	49.22	20.65	53.86	46.14	0.438	0.421	2.48	13.93
35.	JsH3	30.73	61.46	68.50	15.03	38.54	25.56	22.96	32.09	14.33	52.10	47.9	0.475	0.455	1.91	12.61
36.	CbH1	28.20	54.74	63.33	12.89	36.14	24.63	22.07	28.37	13.48	51.79	48.21	0.459	0.486	1.71	13.07
37.	CbH2	17.72	35.43	40.33	8.50	22.45	14.74	16.95	18.62	8.32	52.57	47.43	0.457	0.449	1.15	13.00
38.	LkH1	16.27	32.53	35.50	7.80	20.53	13.56	16.07	17.20	7.53	52.78	47.22	0.460	0.447	0.96	12.50
39.	LkH2	28.88	57.75	64.00	14.18	36.62	24.02	22.28	29.94	13.63	51.86	48.14	0.475	0.457	1.55	13.39
40.	GlK1	29.67	59.34	65.00	14.23	37.46	24.64	22.57	31.19	13.92	52.53	47.47	0.459	0.451	1.72	13.97
41.	GlK2	21.24	42.48	47.50	10.33	26.59	17.41	18.67	22.33	9.82	52.38	47.62	0.472	0.452	1.32	10.63
42.	HmH1	27.50	55.00	60.83	13.19	34.51	22.64	21.51	29.12	12.69	52.77	47.23	0.463	0.448	1.52	13.11
43.	HmH2	31.87	63.73	70.00	15.28	40.46	26.74	23.56	33.75	14.70	52.97	47.03	0.456	0.438	1.81	12.50
44.	HmH3	80.58	92.33	178.83	21.64	58.87	38.78	37.26	49.36	21.32	53.49	46.51	0.441	0.433	2.53	16.95
45.	JdH1	34.72	64.56	77.50	17.24	42.80	27.48	23.92	31.08	16.24	48.10	51.90	0.561	0.525	2.08	12.76
46.	CeH1	31.34	62.67	69.50	15.03	39.62	26.08	23.40	32.83	14.81	52.35	47.65	0.460	0.454	1.90	14.95
47.	CeH2	27.40	54.80	60.83	13.14	34.68	22.65	21.78	28.86	12.79	52.65	47.35	0.458	0.445	1.65	15.15
48.	CeH3	57.06	118.17	126.67	28.49	70.84	48.39	31.31	73.22	16.47	61.92	38.08	0.390	0.226	1.94	8.93
49.	GuH1	24.96	53.68	55.83	12.94	34.66	22.67	19.63	28.04	12.70	52.15	47.85	0.470	0.461	1.70	14.03
50.	JiH1	25.7	51.41	56.17	12.20	32.93	19.67	20.00	27.46	11.75	53.33	46.67	0.451	0.437	1.49	13.04
51.	JiH2	21.24	42.47	46.83	10.02	26.94	18.87	18.00	22.47	9.99	52.91	47.09	0.448	0.447	1.27	11.92
52.	BdH1	40.54	81.09	90.67	19.78	51.40	33.22	23.91	42.45	18.86	52.33	47.67	0.469	0.450	2.15	17.87
53.	BdH2	33.87	69.40	75.83	16.24	42.51	30.93	23.15	36.97	16.19	53.20	46.80	0.440	0.442	2.07	11.61
54.	JrH1	24.43	48.86	60.00	11.72	30.97	20.00	18.41	25.67	11.47	52.57	47.43	0.457	0.448	1.54	14.92
55.	MiH1	26.41	62.82	58.33	15.06	39.61	26.21	20.80	33.10	14.66	52.67	47.33	0.457	0.447	1.76	12.08
56.	KgH1	46.16	169.12	104.5	40.31	68.98	50.84	26.66	112.00	16.80	66.21	33.79	0.360	0.150	2.00	8.89
57.	HbH1	27.41	88.76	80.83	21.29	55.90	39.40	22.23	46.73	20.75	52.59	47.41	0.459	0.450	2.53	13.72
58.	CnK1	20.67	41.34	46.00	9.91	26.28	17.29	18.40	21.66	9.77	52.40	47.60	0.459	0.451	1.49	9.68
59.	CnK2	19.73	39.46	44.67	9.46	24.97	16.50	17.88	20.73	9.27	52.54	47.46	0.458	0.449	1.17	11.36
60.	CnK3	31.18	62.36	69.67	14.95	39.61	26.00	23.10	32.69	14.72	52.44	47.56	0.458	0.451	1.71	12.45

(Contd.)

Sl. no.	Tree code	Fruit dimen-sions (cm^2)	Fruit weight (g)	Fruit volume (ml)	Stone weight (g)	Stone length (mm)	Stone width (mm)	Stone thickness (mm)	Pulp weight (g)	Peel weight (g)	Edible portion (%)	Non-edible portion (%)	Stone: pulp	Peel: Pulp	Skin thickness (mm)	TSS (°Brix)
61.	BdK1	27.07	55.80	60.83	12.98	33.83	22.26	21.28	30.23	12.60	54.15	45.85	0.431	0.418	1.61	13.22
62.	BdK2	23.11	44.55	50.00	10.84	29.56	19.40	19.65	22.66	11.05	50.76	49.24	0.484	0.504	1.42	11.55
63.	MiK1	27.96	55.93	61.33	13.66	35.34	23.18	21.86	28.96	13.30	51.68	48.32	0.478	0.464	1.59	12.73
64.	MiK2	29.08	58.16	64.50	13.95	36.92	24.11	22.15	30.58	13.63	52.58	47.42	0.459	0.448	1.72	10.68
65.	KlK1	23.89	46.10	53.50	10.82	30.65	18.55	19.99	23.85	11.42	51.75	48.25	0.457	0.488	1.47	9.93
66.	KlK2	20.70	41.40	45.50	9.93	26.35	17.91	18.44	21.65	9.82	52.29	47.71	0.461	0.454	1.25	8.45
67.	KlK3	31.54	64.75	70.33	15.46	39.43	26.21	23.14	34.63	14.66	53.47	46.53	0.447	0.424	1.71	12.00
68.	KaK1	20.04	40.08	45.00	9.61	25.35	17.38	17.97	21.13	9.34	52.67	47.33	0.459	0.446	1.30	12.02
69.	KaK2	22.13	44.26	49.67	10.61	27.94	17.92	18.96	23.37	10.28	52.71	47.29	0.461	0.446	1.26	11.82
70.	TrK1	48.02	164.66	140.00	37.09	57.38	39.05	26.55	105.47	22.10	64.06	35.94	0.353	0.211	2.49	18.37
71.	NiK1	30.75	62.35	67.50	14.75	38.69	25.59	22.92	33.14	14.46	53.13	46.87	0.447	0.437	1.95	12.68
72.	NlK2	31.49	63.81	70.00	15.10	38.75	25.69	23.07	34.11	14.60	53.43	46.57	0.445	0.431	1.83	13.00
73.	RrK1	28.80	59.22	65.83	13.81	36.07	23.79	21.98	32.04	13.37	54.09	45.91	0.432	0.418	1.69	13.90
74.	SnK1	32.60	65.20	71.67	15.64	40.97	27.17	23.62	34.31	15.25	52.52	47.48	0.461	0.452	1.85	11.08
75.	SaK1	19.98	39.95	45.00	9.58	25.21	16.86	17.96	21.04	9.33	52.64	47.36	0.458	0.447	1.31	12.33
76.	MjK1	30.60	61.20	67.83	14.68	38.85	25.46	22.79	32.17	14.36	52.57	47.43	0.459	0.448	1.68	12.48
77.	MjK2	31.84	63.67	70.33	15.27	40.02	26.53	23.31	33.51	14.89	52.57	47.43	0.459	0.450	1.83	14.74
78.	BpK1	16.30	32.60	37.17	7.82	20.61	13.61	16.12	17.07	7.72	52.31	47.69	0.461	0.455	1.12	9.93
79.	BpK2	30.66	62.99	68.33	14.71	38.30	24.37	22.80	34.00	14.28	53.96	46.04	0.435	0.421	1.63	12.33
80.	BrK1	45.54	90.00	103.83	21.84	56.16	37.78	28.35	46.74	21.42	51.93	48.07	0.469	0.464	2.53	10.00
81.	BrK2	26.20	56.17	57.83	12.57	33.34	21.78	21.19	30.98	12.62	55.13	44.87	0.407	0.412	1.74	13.05
	Range	13.98 -80.58	27.55-169.12	31.50-178.83	6.34-40.31	17.78-71.47	10.9-51.28	14.83-37.26	14.04-112.00	6.16-27.03	48.10-66.21	33.79-51.9	0.353-0.561	0.15-0.547	0.86-2.96	8.45-18.37
	Mean±SE	28.24 ±1.21	60.62 ±3.20	65.57 ±3.16	14.43 ±0.75	35.78 ±1.42	24.17 ±0.99	21.31 ±0.45	33.00 ±2.06	13.18 ±0.50	53.35 ±0.32	46.64 ±0.32	0.455 ±0.00	0.435 ±0.01	1.63 ±0.05	12.09 ±0.22
	SD	10.9	28.84	28.4	6.73	12.8	8.89	4.03	18.56	4.49	2.91	2.91	0.03	0.06	0.48	2.02
	CV (%)	38.59	47.57	43.32	46.59	35.77	36.79	18.9	56.23	34.04	5.45	6.24	7.57	14.65	29.2	16.68

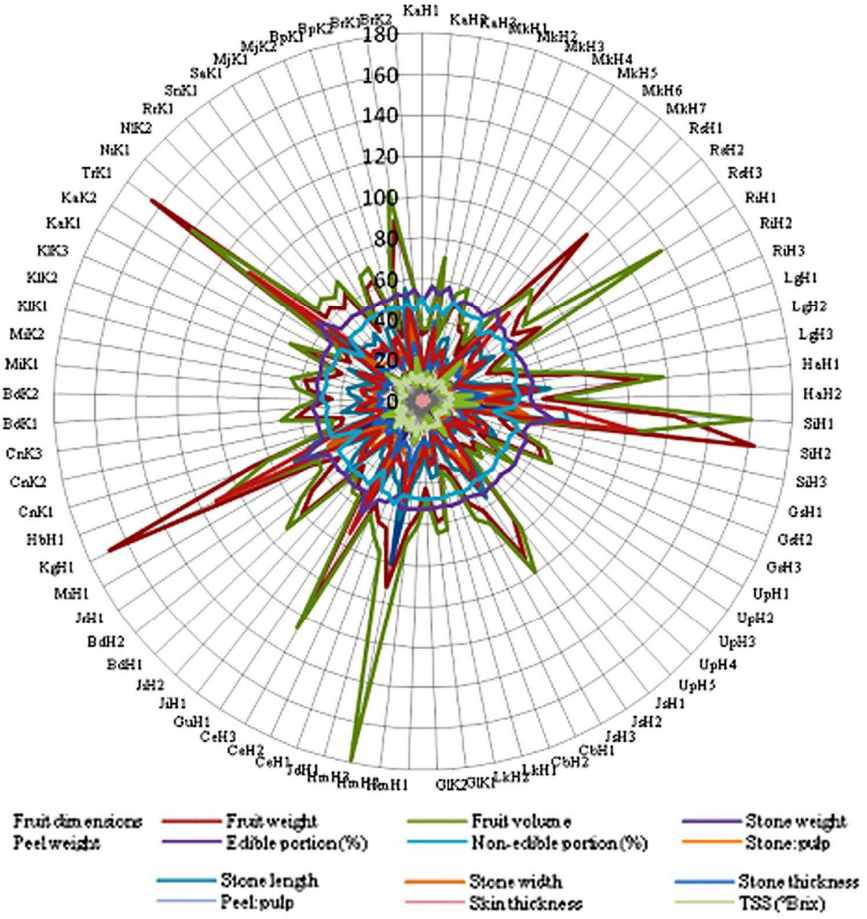

Chart 1. Extent of variation in fruit characters of seedling origin mango tree in Himachal Pradesh**.**

mango cultivars in different agro-climatic conditions across the Indian sub-continent. These are mostly similar but having different names to avoid confusion a careful classification based upon additional taxonomical characters like stone characters needed to be supplemented with present distinguishing characters (Teaotia 1971, Singh and Bana 1976). Further, it is a prerequisite for fruit breeders to design a breeding program considering viable strategy which boosts commercial utility of mango fruit. Thus, stone characters are very much vital for commercial exploitation in mango processing industries (Sadhu and Bose 1982) (Table 1 and Chart 1). Pulp weight ranged from 14.04 (MkH6) to 112.00 g (KgH1) with an average of 33.00 g. The coefficient of variation was recorded as 56.23 per cent. Peel weight ranged from 6.16 (MkH1) to 27.03 g (SiH1) with an average of 13.18 g. The coefficient of variation was recorded as 34.04%. Per cent edible portion in sampled mango fruit varied from 48.10 (JdH1) to 66.21 (KgH1) with an average of 53.35. The coefficient of variation was recorded as 5.45%. Per cent non-edible portion sampled mango fruit ranged between 33.79 (KgH1) and 51.9 (JdH1) with an average of 53.35. The coefficient of variation was recorded as 6.24%. Ratio of weight of stone to weight of pulp varied from 0.353 (TrK1) to 0.561 (JdH1) with an average of 0.455. Coefficient of variation was recorded as

Table 2. Extent of variation in yield characters of seedling origin mango tree in Himachal Pradesh.

Sl. No.	Tree code	On year		Off year	
		Yield (kg/tree)	Yield efficiency (kg/cm^2)	Yield (kg/tree)	Yield efficiency (kg/cm^2)
1.	KaH1	65.20	0.0169	5.10	0.0013
2.	KaH2	61.40	0.0238	3.50	0.0014
3.	KaH3	50.70	0.0176	1.60	0.0006
4.	MkH1	109.30	0.0175	2.30	0.0004
5.	MkH2	60.20	0.0262	4.10	0.0018
6.	MkH3	70.60	0.0077	0.50	0.0001
7.	MkH4	200.20	0.0174	20.65	0.0018
8.	MkH5	90.30	0.0118	7.36	0.0010
9.	MkH6	260.60	0.0253	21.41	0.0021
10.	MkH7	84.30	0.0103	7.40	0.0009
11.	RsH1	193.70	0.0168	4.10	0.0004
12.	RsH2	45.40	0.0129	2.90	0.0008
13.	RsH3	60.20	0.0625	1.76	0.0018
14.	RiH1	109.30	0.0260	1.25	0.0003
15.	RiH2	91.80	0.0158	3.10	0.0005
16.	RiH3	99.10	0.0148	5.80	0.0009
17.	LgH1	30.30	0.0470	0.00	0.0000
18.	LgH2	57.40	0.0427	5.20	0.0039
19.	LgH3	42.50	0.0441	2.50	0.0026
20.	HaH1	80.70	0.0176	8.10	0.0018
21.	HaH2	244.60	0.0392	21.20	0.0034
22.	SiH1	223.10	0.0194	20.50	0.0018
23.	SiH2	168.40	0.0480	4.60	0.0013
24.	SiH3	83.10	0.0322	3.10	0.0012
25.	GsH1	260.20	0.0226	20.20	0.0018
26.	GsH2	146.40	0.0417	6.41	0.0018
27.	GsH3	157.20	0.0292	7.20	0.0013
28.	UpH1	326.50	0.0284	5.60	0.0005
29.	UpH2	197.80	0.0341	8.20	0.0014
30.	UpH3	218.30	0.0326	6.43	0.0010
31.	UpH4	120.90	0.0344	9.30	0.0026
32.	UpH5	246.70	0.0322	7.60	0.0010
33.	JsH1	322.50	0.0266	5.32	0.0004
34.	JsH2	305.30	0.0266	20.10	0.0017
35.	JsH3	266.10	0.0289	6.34	0.0007
36.	CbH1	287.60	0.0312	6.70	0.0007
37.	CbH2	348.70	0.0303	7.80	0.0007
38.	LkH1	46.50	0.0346	5.60	0.0042
39.	LkH2	77.60	0.0337	6.20	0.0027
40.	GlK1	49.80	0.0370	1.30	0.0010
41.	GlK2	29.10	0.0162	0.00	0.0000
42.	HmH1	41.60	0.0363	4.90	0.0043
43.	HmH2	34.30	0.0532	3.10	0.0048

(Contd.)

(Contd.)

Sl. no.	Tree code	On year		Off year	
		Yield (kg/tree)	Yield efficiency (kg/cm^2)	Yield (kg/tree)	Yield efficiency (kg/cm^2)
44.	HmH3	28.90	0.0567	9.40	0.0184
45.	JdH1	83.10	0.0216	0.00	0.0000
46.	CeH1	310.40	0.0270	4.21	0.0004
47.	CeH2	267.10	0.0274	11.40	0.0012
48.	CeH3	230.10	0.0301	10.20	0.0013
49.	GuH1	68.30	0.2030	0.00	0.0000
50.	JiH1	78.20	0.0303	2.98	0.0012
51.	JiH2	108.70	0.0258	6.92	0.0016
52.	BdH1	14.10	0.0105	0.00	0.0000
53.	BdH2	43.60	0.0169	1.20	0.0005
54.	JrH1	149.80	0.1307	7.65	0.0067
55.	MiH1	19.40	0.0144	0.50	0.0004
56.	KgH1	96.50	0.0166	0.00	0.0000
57.	HbH1	34.60	0.0679	1.87	0.0037
58.	CnK1	47.80	0.0355	0.68	0.0005
59.	CnK2	31.60	0.0110	0.27	0.0001
60.	CnK3	25.30	0.0188	0.43	0.0003
61.	BdK1	50.70	0.0176	2.76	0.0010
62.	BdK2	40.50	0.0628	3.19	0.0049
63.	MiK1	231.70	0.0202	7.31	0.0006
64.	MiK2	238.90	0.0178	8.91	0.0007
65.	KlK1	30.50	0.0473	0.61	0.0009
66.	KlK2	26.50	0.0411	0.94	0.0015
67.	KlK3	27.40	0.0538	0.00	0.0000
68.	KaK1	31.20	0.0232	0.00	0.0000
69.	KaK2	43.10	0.0320	0.00	0.0000
70.	TrK1	374.30	0.0280	3.87	0.0003
71.	NiK1	14.80	0.0186	0.00	0.0000
72.	NlK2	5.40	0.0056	0.00	0.0000
73.	RrK1	12.60	0.0195	0.00	0.0000
74.	SnK1	43.80	0.0382	2.78	0.0024
75.	SaK1	38.60	0.0168	5.94	0.0026
76.	MjK1	57.20	0.0163	2.93	0.0008
77.	MjK2	39.60	0.0154	0.00	0.0000
78.	BpK1	63.70	0.0473	1.48	0.0011
79.	BpK2	50.10	0.0777	2.10	0.0033
80.	BrK1	106.40	0.0412	3.76	0.0015
81.	BrK2	40.70	0.0227	6.95	0.0039
Range		5.4 - 374.3	0.0056 - 0.203	0.0 - 21.41	0.0 - 0.0184
Mean ± SE		114.45 ± 10.91	0.03 ± 0.0029	5.03 ± 0.59	0.0015 ± 0.0002
SD		98.25	0.026	5.35	0.002
CV (%)		85.85	81.77	106.46	149.43

7.57%. Ratio of peel weight to pulp weight varied from 0.15 (KgH1) to 0.547 (MkH6) with an average of 0.435. Coefficient of variation was recorded as 14.65%. Pulp weight and per cent of edible portion are important characters from economic point of view. Thickness of skin ranged from 0.86 (UpH5) to 2.96 mm (HaH1 and SiH1) with an average of 1.63 mm. Coefficient of variation was recorded as 29.20%. There exists considerable variations in pulp and peel weight. But, when it comes to edible and non-edible portion percentage; also, stone to pulp ratio the distinctness among these characters is very low. From processing point of view mango should be pulpier having thinner skin and smaller stone. Lower pulp : stone in fruits makes it suitable for pickling industries (Nalini and Chimmad 2005). Depending upon the objectives of breeding program selection of donor parent should be carefully done. These results are in accordance with the results reported by Gangolly *et al*. (1957), Lodh *et al.* (1974), Rabbani and Singh (1988), Mannan *et al.* (2003). TSS (Total soluble solids) varied between 8.45 (KlK2) and 18.37 ºBrix (TrK1) with an average of 12.09 ºBrix. Coefficient of variation was recorded as 16.68. TSS content of a solution is determined by the index of refraction. It is widely used during fruit processing to determine the concentration of sugar in the products. During the development of the flesh of a fruit, in many species, nutrients are deposited as starch, which during the ripening process is transformed into sugars. The progression of the ripening process leads to increase in sugar levels. Sweetness of the pulp is the most essential criterion for table or sucking purpose of seedling mangoes. TSS is highly heritable so, strains possessing higher TSS can be directly selected as donor parent or utilized as parent in hybridization program. The consumptive use of mangoes like table, processing, sucking, etc. demands specific type of mango, lower TSS mostly preferred for processing while higher TSS preferred for table/sucking purposes (Das *et al.* 2007, Sunagar *et al*. 2015) (Table 1 and Chart 1). During 'on' year *i.e.* in 2014 sampled seedling mango trees flowered profusely ensuing in decent fruit harvest. The variation in terms of yield observed ranged from 5.40 (NlK2) to 374.30 kg/plant (TrK1) with an average of 114.45 kg fruits per plant. The coefficient of variation was 85.85%. There was exponential decrease in yield of fruits per plant. Many sampled trees failed to bear fruits but some of them managed to secure a little bit of it. The fruit yield in kg per plant varied between 0.00 and 21.41 (MkH6) with an average of 5.03 kg fruits per plant. The coefficient of variation was 106.46% (Table 2). The potential to yield in mango seems to be affected by additive gene which could be influenced by environmental factors. During 'on' year *i.e.* in 2014 yield potential ranged between 0.0056 kg/cm^2 (NlK2) and 0.203 (TrK1) with an average of 0.03 kg/cm^2. The coefficient of variation was 81.77%. In 'off' year i.e. 2015 observed data revealed wide range of variations in yield potential. There were many sampled trees which failed to bear fruit. The range of variation observed was 0.00 to 0.184 kg/cm^2 (HmH3) with an average of 0.0015 kg/cm^2. The coefficient of variation observed was 149.43%. The existing mango tree population originated from seedlings not only adds to biological diversity but can also be utilized in different mango breeding programs for development of superior varieties.

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