

Studies on harvest maturity of Mallika and Amrapali mango cultivars grown under the submontane region of Himachal Pradesh

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ABSTRACT

Amrapali and Mallika are the newly introduced mango cultivars in the low hill regions of Himachal Pradesh. The studies were conducted for the standardization of optimum fruit maturity for harvesting of these cultivars under the low hill conditions (400 to 1000 m a.m.s.l.) of the state. It has been concluded from the studies that at lower altitudes (upto 700 m), Mallika cultivar attained harvest maturity during 2nd week of August and at higher altitudes it became ready for harvesting by 3rd week of August. Amrapali cultivar attained harvest maturity by 2nd week of August in this region irrespective of the altitudinal variation. Quality was not much affected due to location.

Key words: Mallika, Amrapali, mango, maturity, harvesting time, fruit quality.

INTRODUCTION

Mango has wide adaptability and thrives in a wide range of climatic and soil conditions. In Himachal Pradesh its cultivation gained momentum during early eighties in the lower Shiwalik region. Horticulturists of the region are adopting its cultivation due to the remunerative price they get from the market; as mango grown in this region matures at a time when it is over from other parts of the country. Mallika and Amrapali are the newly introduced cultivars in this region. Being regular in bearing and adapted to higher planting densities, growers are showing more interest in these cultivars. Being late in maturity in comparison to other popular cultivars like Dashehari and Langra, growers are harvesting the fruits of these cultivars at improper maturity stages.

Due to lack of information on ideal stage of fruit maturity and harvesting, growers are not fetching the due returns. This problem was regarded as a researchable issue by Agricultural Technology Management Agency, Hamirpur and was taken up at the Regional Horticultural and Forestry Research Station, Neri, Hamirpur to conduct studies on the proper maturity stages of Mallika and Amrapali cultivars under low hill growing areas of Himachal Pradesh.

MATERIALS AND METHODS

The studies were conducted during 2004-2007 at in Hamirpur district which lies between 76° 16" to 76° 43" E longitudes and 31° 35' to 31° 55" N latitudes with an altitudinal variation of 400 to 1000 m above mean sea level. Four locations were selected with variable altitudes ranging from <600, 600-700, 700-800, >800 m amsl. In order to find out the correct stage of harvest

maturity five dates of harvest were selected for each cultivar at weekly intervals starting from last week of July. After harvesting the fruits were kept at room temperature for sixteen days and the observations on various fruit physico-chemical characteristics were recorded at four day intervals. Fruit weight, fruit size, specific gravity, total soluble solids, acidity, specific gravity and fruit (pulp and peel) colour were studied. The stage of optimum maturity was defined as the date of harvest at which the fruits attained highest values for the various physico-chemical characteristics after harvest, *i.e.* during shelf-life. All the physico-chemical and statistical analyses were done as per standard procedures described by AOAC (1), Gomez and Gomez (2), and Mazumdar (8).

RESULTS AND DISCUSSION

Data on various fruit characteristics recorded at different harvest dates are presented in Table 1. It is evident that fruit weight of Mallika cultivar increased upto 2nd week of August, the increase beyond this date was marginal. Fruit size also exhibited similar pattern. The pulp TSS kept on increasing with delay in harvesting but highest value was achieved when the fruits were harvested during 2nd week of August. The increase in TSS at this date of harvest may be attributed to the fact that by this date the fruits were having highest level of starch and insoluble carbohydrates, which were converted into soluble sugars and other compounds during the process of ripening. During the later dates these soluble solids were utilized for respiration; thus showing lower TSS during the ripening of the fruits which were harvested late. Earlier, Lebrun *et al.* (5), and Singh *et al.* (11) also reported increase in sugars and fruit weight with the advancement in the date

Table 1. Fruit physico-chemical characteristics of 'Mallika' cultivar of mango at different harvesting dates.

Date of harvest	Days after harvest	Fruit characters							
		Weight (g)	Length (cm)	Dia. (cm)	TSS (°B)	Acidity (%)	Sp. gravity	Peel colour	Pulp colour
4 th week of July	0	396	13.2	7.6,7.0	8.0	0.85	0.97	Green	White
	4	391	-	-	9.1	0.74	0.98	-do-	-do-
	8	382	-	-	10.2	0.67	0.97	-do-	-do-
	12	378	-	-	11.4	0.59	0.94	-do-	-do-
	16	372	-	-	13.2	0.52	0.91	G-yellow	-do-
1 st week of Augsut	0	413	13.4	7.8, 7.1	9.3	0.73	0.99	light green	white
	4	408	-	-	12.4	0.68	0.97	-do-	-do-
	8	402	-	-	14.2	0.63	0.96	Y-green	Light Yel
	12	397	-	-	14.4	0.57	0.94	-do-	-do-
	16	393	-	-	15.7	0.49	0.91	-do-	-do-
2 nd week of August	0	417	13.6	7.7, 7.2	12.3	0.59	1.04	Y-green	Y-white
	4	416	-	-	14.4	0.51	0.10	Yellow	Yellow
	8	415	-	-	16.6	0.46	1.01	-do-	-do-
	12	411	-	-	17.6	0.39	1.02	-do-	-do-
	16	406	-	-	20.4	0.34	1.02	-do-	-do-
3 rd week of August	0	417	13.5	7.8, 7.1	13.0	0.50	1.09	Y-green	Light Yell
	4	415	-	-	14.8	0.44	1.04	Yellow	Yellow
	8	410	-	-	16.1	0.41	1.03	-do-	-do-
	12	408	-	-	17.4	0.38	1.00	-do-	-do-
	16	403	-	-	19.8	0.35	1.02	-do-	-do-
4 th week of August	0	418	13.4	7.7, 7.2	13.2	0.48	1.08	Y-green	Light Yell
	4	412	-	-	14.2	0.48	1.06	Yellow	Yellow
	8	409	-	-	18.4	0.47	1.07	-do-	Yellow
	12	407	-	-	19.2	0.41	1.08	-do-	-do-
	16	400	-	-	19.7	0.36	1.06	-do-	-do-

of harvest in mango. Fruit acidity also reduced with delay in harvesting but lowest value for the ripened fruits was recorded when fruits were harvested during 2nd week of August. The decrease in acidity might be attributed to the conversion of acids into sugars (Pool *et al.*, 9). As far as specific gravity of the harvested fruits was concerned, there was observed no specific interrelation between specific gravity and the fruit maturity at different dates of harvest. Narayana *et al.* (7) also observed no conclusive influence of specific gravity on harvest maturity of Baneshan mango. As far as the peel and pulp colour is concerned; fruits developed yellowish colour by 2nd week of August. Jha

et al. (3), and Malevski *et al.* (6) also reported change in fruit colour as a reliable index of maturity in mango. Further analysis of data with respect to dates of harvest and location (Table 2) revealed that at locations I and II, *i.e.* below 700 m amsl; the increase in fruit weight was not significant beyond first week of August, whereas TSS and acidity, increased and decreased respectively but variation was not significant after 2nd week of August. Variation in specific gravity was not significant. At locations III and IV, *i.e.* above 700 m amsl the increase in fruit weight was significant. With the delay in harvesting, acidity reduced significantly upto 3rd week of August, variation in specific gravity was also

Table 2. Interaction effect of location and date of harvest on fruit characteristics of Mallika mango.

Fruit characteristic	Fruit weight (g)					TSS (°B)					Acidity (%)					Specific gravity					
	Location	L1	L2	L3	L4	Mean	L1	L2	L3	L4	Mean	L1	L2	L3	L4	Mean	L1	L2	L3	L4	Mean
D1		396	410	400	376	396	8.2	8.0	8.0	7.6	8.0	0.82	0.81	0.89	0.87	0.85	0.97	0.97	0.96	0.97	0.97
D2		418	422	408	402	413	10.4	9.6	8.7	8.4	9.3	0.74	0.62	0.76	0.79	0.73	1.00	1.00	0.98	0.99	0.99
D3		422	426	416	402	417	12.8	12.9	11.6	12.0	12.3	0.53	0.51	0.62	0.71	0.59	1.06	1.05	1.02	1.04	1.04
D4		424	428	414	408	417	13.2	13.1	12.7	12.9	13.0	0.50	0.48	0.50	0.52	0.50	1.10	1.08	1.09	1.08	1.09
D5		420	430	420	400	418	13.4	13.5	13.0	13.0	13.2	0.47	0.44	0.52	0.49	0.48	1.07	1.06	1.10	1.10	1.08
Mean		416	423	412	398		11.6	11.4	10.8	13.0		0.61	0.57	0.66	0.68		1.04	1.03	1.03	1.04	
CD at 5%	Location (L)	=				15.9					NS					NS					NS
	Date of Harvest (D)	=				12.7					0.4					0.13					NS
	LxD	=				21.2					1.8					0.15					NS

*Location (L): Altitude above mean sea level: L1- upto 600 m, L2- 600-700 m, L3- 700-800 m, L4- Above 800 m

**Date of Harvest (D): Last week of July onwards at weekly intervals: D1 - Last week July, D2- 1st week August, D3 - 2nd week August, D4 - 3rd week August, D5 - Last week August.

Table 3. Fruit physico-chemical characteristics of 'Amrapali' mango.

Date of harvest	Days after harvest	Fruit characters							
		Weight (g)	Length (cm)	Dia. (cm)	TSS (°B)	Acidity (%)	Sp. gravity	Peel colour	Pulp colour
4 th week of July	0	105	9.7	6.5, 6.1	8.0	0.68	0.96	Green	White
	4	103	-	-	9.6	0.61	0.97	-do-	-do-
	8	101	-	-	10.4	0.52	0.97	-do-	-do-
	12	97	-	-	12.4	0.47	0.97	G-yellow	Light
	16	93	-	-	14.7	0.41	0.98	-	-do-
1 st week of Augsut	0	112	10.1	6.3, 6.0	8.6	0.58	0.97	light green	white
	4	110	-	-	10.4	0.51	0.98	-do-	-do-
	8	109	-	-	12.6	0.47	0.99	Y-green	Light
	12	107	-	-	13.2	0.43	1.00	Yellow	-do-
	16	98	-	-	15.4	0.32	1.01	-do-	-do-
2 nd week of August	0	121	11.7	6.9, 7.0	11.5	0.43	1.00	Y-green	Y-white
	4	117	-	-	14.5	0.38	1.01	Yellow	Yellow
	8	113	-	-	16.6	0.32	1.01	-do-	-do-
	12	109	-	-	17.4	0.30	1.03	-do-	-do-
	16	103	-	-	18.6	0.26	1.01	-do-	-do-
3 rd week of August	0	122	11.5	6.5, 7.1	12.3	0.30	1.02	Y-green	Light
	4	120	-	-	14.2	0.28	1.03	Yellow	Yellow
	8	116	-	-	17.4	0.26	1.01	-do-	-do-
	12	111	-	-	21.0	0.24	1.01	-do-	-do-
	16	104	-	-	20.6	0.22	1.01	-do-	-do-
4 th week of August	0	122	11.6	6.2, 6.3	12.5	0.29	1.02	Y-green	Light
	4	119	-	-	14.4	0.28	1.02	Yellow	Yellow
	8	114	-	-	17.2	0.25	1.01	-do-	-do-
	12	110	-	-	19.8	0.23	1.00	-do-	-do-
	16	101	-	-	19.6	0.21	0.09	-do-	-do-

not very significant under different locations. From the results discussed above it has been concluded that overall 2nd week of August is the appropriate harvest time for Mallika under low hill conditions. Specifically for low lying areas (<700 m amsl) 1st to 2nd week of August was the appropriate time whereas 2nd week to 3rd week was the appropriate time for high altitudinal areas (>700 m). Knight (4) and Rajan and Kumar (10) have also described Mallika as a mid season cultivar which matures a bit late in comparison to its parent Dashehari. They have also supported the variation in the maturity time due to agro-climatic conditions.

In Amrapali, the fruits gained weight with the delay in harvesting upto 3rd week of August but increase beyond 2nd week was marginal (Table 3) as it was observed in Mallika cultivar. Fruit size did not show any specific pattern of increase after 2nd week of August. TSS kept on increasing with the delay in harvesting,

contrarily acidity kept on decreasing. Specific gravity did not change after 3rd week of August. The increase in TSS and specific gravity and decrease in acidity were maximum and minimum respectively when fruits were harvested during 2nd week of August or 3rd week of August. The findings were in conformity with those of Malevski *et al.* (6), Narayana *et al.* (7), and Lebrun *et al.* (5). Further analysis of data with respect to locations and dates of harvest (Table 4) revealed that for locations I and II all the characters studied were at par after 2nd week of August. Whereas, for locations III and IV; fruit weight was not influenced significantly by the dates of harvest at different locations, however, acidity and specific gravity were at par after 3rd week of August. Further, as far as influence of location irrespective of dates of harvest there was not observed any significant effect on the different characters studied; whereas, 2nd week of August was found to be ideal time

Table 4. Effect of location and date of harvest on fruit characteristics of Amrapali mango.

Fruit characteristic	Fruit weight (g)					TSS (°B)					Acidity (%)					Specific gravity				
	L1	L2	L3	L4	Mean	L1	L2	L3	L4	Mean	L1	L2	L3	L4	Mean	L1	L2	L3	L4	Mean
D1	102	104	107	108	105	8.1	8.0	8.1	7.8	8.0	0.64	0.72	0.70	0.67	0.68	0.98	0.96	0.95	0.96	0.96
D2	112	110	112	112	112	8.4	8.9	8.7	8.2	8.6	0.53	0.64	0.62	0.54	0.58	0.97	0.98	0.97	0.97	0.97
D3	124	126	116	119	121	12.4	11.4	11.7	1.4	11.5	0.32	0.44	0.52	0.43	0.43	1.04	1.01	0.98	0.98	1.00
D4	124	125	120	121	122	12.6	12.2	12.0	12.2	12.3	0.30	0.30	0.28	0.31	0.30	1.01	1.04	1.01	1.01	1.02
D5	126	126	118	119	122	12.8	12.4	12.2	12.4	12.5	0.28	0.29	0.29	0.28	0.30	1.02	1.01	1.02	1.02	1.02
Mean	118	118	115	116		10.7	10.6	10.5	10.2		0.21	0.29	0.28	0.45		1.00	1.00	0.99	0.99	
CD at 5%	Location (L) = NS					NS					NS					NS				
	Date of Harvest (D) = 8.7					1.02					0.12					0.03				
	L×D = 14.2					2.12					0.15					0.05				

*Location (L): Altitude above mean sea level: L1- upto 600 m, L2- 600-700 m, L3- 700-800 m, L4- Above 800 m

**Date of harvest (D): Last week of July onwards at weekly intervals: D1 - Last week July, D2 - 1st week August, D3 - 2nd week August, D4 - 3rd week August, D5 - Last week August.

of harvest irrespective of locations. Rajan and Kumar (10) reported good performance of this cultivar under the hilly conditions and also supported variation in its maturity time under different agro-climatic conditions. From these results it has been concluded that after 2nd week of August there was no influence of location on the harvest maturity of Amrapali cultivar and it can be harvested at 2nd week of August irrespective of the altitudinal variation in the low hill region of Himachal Pradesh.

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