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Effect of heat units and time period on maturity indices of different varieties of mango (*Mangifera indica* L.)

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Abstract

An investigation entitled “Effect of heat units and time period on maturity indices of different varieties of mango (*Mangifera indica* L.)” was undertaken at AICRP Irrigation and water management field, Department of Horticulture, College of Agriculture Parbhani, University, Vansantrao Naik Marathwada Krishi Vidyapeeth Parbhani. The experiment was laid out in RBD with four treatments of mango. The mango fruit harvested from tree were selected for the study and in each tree. From result of present investigation its revealed that among different time period taken for maturity significantly influenced the physical parameter, quality parameter, time taken to maturity cv. Kesar, Neelum, Mallika, Totapuri. Fruits of Kesar variety with accumulation of 1320 HU was found to be best. Fruits of kesar variety reported better physical characteristics and quality parameter like TSS, minimum acidity, reducing sugar, non-reducing sugar and total sugar.

Keywords: Heat units, maturity indices, varieties, mango (*Mangifera indica* L.)

Introduction

Mango (*Mangifera indica* L.) unarguably is one of the oldest and choicest tropical fruit of the world and is rightly designated as “King” of all fruits. Mango belongs to family Anacardiaceae, which is originated in Indo-Burma at an early date. The word 'mango' originated as early as 16th century from the ancient Tamil word 'mangos'. Historical records suggest that its cultivation as a fruit tree originated in India around 4000 years ago. It was virtually unknown to any botanist until 1605 when Carol Clusius first mentioned of it in its writings. The name *Mangifera* was given for the first time by bontius in 1658 when he referred to this plant as arbor mangifera (as tree producing mango). Later it was mentioned in the literature as *Mangifera indica*, *Mangifera domestica* or *Mangifera sylvatica*. In the early period of domestication, mango trees probably yielded small fruits, but folk selection of superior seedlings over many hundreds of years would have resulted in the production of larger fruits. Before 1970, mangoes were little known to consumers outside the tropics and the trade involving fresh fruit was non-existent. Around 2000 varieties of mangoes are found in the world. Out of them, majority of varieties are cultivated in India. India produces around 19.68 million metric tonne of mangoes every year from 2.26 million ha area (Anon., 2017) [1]. Gujarat itself produces 13 lakh tons of mango which contributes around 7 per cent in the total lot. Especially in Junagadh district total of 84120 tonne mango produce from 21ha area (Anon., 2017) [1].

Heat unit

The idea of Heat Unit or Growing Degree Days was introduced almost in 1730, by the French scientist Rene A. F. de Reaumur. Since that time, Heat Unit has been used as a means to predict the growth stages of many living organisms. Growing Degree Days (GDD) are also called Growing Degree Units (GDUs) or Heat Units (HUs).

The Heat Unit concept is based on the following assumptions.

- Growth or development occurs only when the average daily temperature exceeds a certain threshold, known as the base temperature, below which the organism does not grow or grows slowly.
- Growth and development are closely related to daily mean temperature accumulations above the base tem.
- For a given species, the number of accumulated heat units between growth stages remains constant across years, locations, and climate.
- A certain amount of heat is required to provide enough energy for the organism to move

to the next development stage, which depends on weather conditions, the amount of time can vary.

HU are the number of temperature degrees above a certain threshold (base) temperature within consecutive 24 hrs of period or a Heat unit is defined as a mean daily temperature one degree above (base) temperature.

$HU \text{ or GDD} = \text{Mean Daily Temperature} - \text{Certain (Base) Temperature}$.

Material and Method

The experiment was conducted at AICRP Irrigation and water management field, Department of Horticulture, College of Agriculture, Vansantrao Naik Marathwada Krishi Vidyapeeth Parbhani. During investigation physical characteristics of mango fruit were evaluated immediately after harvest stage. The experimental material consists of fruit of Kesar, Mallika, Neelum, Totapuri varieties were obtained from AICRP Irrigation and water management field, Department of Horticulture, College of Agriculture, Vansantrao Naik Marathwada Krishi Vidyapeeth Parbhani. Forty-eight uniform mango tree of each treatment selected for the study. The tagged fruit of uniform size were harvested for conducting experiment. The experiment was laid out with RBD with three replication and four treatments viz, T₁ Kesar, T₂ Mallika, T₃ Neelum, T₄ Totapuri. The observation was recorded and when immediately after harvest stage. For studying physical parameter ten fruits were randomly selected and observation were recorded on the physical characteristics i.e. Length of fruit, Length of stone, Breadth of fruit, Breadth of stone, Weight of fruit, Weight of pulp, Weight of peel, Weight of stone, Pulp: Stone ratio. Statistical analysis of data of various characters will be carried out as per Randomized Block Design. Analysis of variance will be worked out using standard statistical procedures as described by Panse and Sukhatme (1985) [17].

Result and discussion effect of heat unit

The initially fruit maturities are required for maximum heat unites are required T₄ i.e., Totapuri (1529 HU). Whereas minimum heat unites are required T₁ i.e., Kesar (1320 HU). The results also founding heat unites required for maximum and minimum heat unites are required. The similar results also founding Estrada *et al.* (1996) [28] Shinde *et al.* (2001) [29], Kanzaria (2015) [27], Halepotara, *et al.* (2019) [8].

Effect of physical parameter

Looking to the length of fruits are measured the maximum length of fruit is T₄ i.e., Totapuri (12.65). The results reported by Pandey *et al.* (1974) [15], Kudachikar *et al.* (2003) [9] and Padhiar *et al.* (2011) are in accordance with the present study. Data records minimum fruit length of stone T₁ kesar and maximum length of stone is T₄ Totapuri. It was discovered that the date of harvesting had an effect on the length of the stone. These findings are also supported with results of Shafique *et al.* (2006) [21], Lechaudel and Joas (2006) [11] and Lucena *et al.* (2007) [12]. Looking to the breadth of fruits, it was observed that the content of breadth of fruit was increased with progress in days. The maximum breadth of fruit T₄ i.e., Totapuri (7.80 cm) was recorded. These findings are also supported with results of Patil (1996) [31], Obasi (2004) [14]. The data indicated that the minimum stone breadth T₁ i.e., Kesar (3.36 cm) was recorded. These findings are also

supported with results of Patil (1990) [19], Patil (1996) [31], Obasi (2004) [14], Dutta and Dhua (2004) [4]. The highest weight of fruit was recorded in fruits harvested T₄ i.e., Totapuri (24.92) was recorded. Similar findings have also been obtained by Roy *et al.* (1972) [2], Palaniswamy (1974) [18], Gole (1986) [7]. The maximum weight of pulp T₄ i.e., Totapuri (248.86 g) was recorded. Similar findings have also been obtained by Roy *et al.* (1972) [2], Sadhu and Bose (1976) [26], Patil (1990) [19], Kudachikar *et al.* (2003) [9], Obasi (2004) [14], Dutta and Dhua (2004) [4], Shafique *et al.* (2006) [21], Lechaudel and Joas (2006) [11] and Lucena *et al.* (2007) [12]. The highest weight of peel was recorded in fruit harvested T₄ i.e., Totapuri (24.92 g) was recorded. Similar findings have also been obtained by Roy *et al.* (1972) [2], Sadhu and Bose (1976) [26], Patil (1990) [19], Kudachikar *et al.* (2003) [9]. The minimum weight of stone T₃ i.e., Neelum (53.38 g) was recorded. The results were supported, Padhiar *et al.* (2011) [16]. It is observed that the pulp: stone ratio T₁ i.e. Kesar (4.90) of fruit was higher. These findings are consistent with those of Shyamal and Mishra (1987) [22] and Kanzaria (2015) [27].

Effect of chemical parameter

The titrable acidity of fruits gradually decreased with the progress of days towards harvest in all the treatments. The titrable acidity percentage T₂ i.e., Mallika (0.23%) was lower was recorded. Similar outcomes were obtained. also earlier reported by Abourayya *et al.* (2011) [2], Emmanuel *et al.* (2009) [5], Dang *et al.* (2008) [3], Lebrun *et al.* (2008) [10] and Tridjaja and Mahendra (2000) [25] in mango. Among the maturity stages, higher level of reducing sugar T₁ i.e., Kesar (6.28%) was registered. These results are in close proximity with the earlier findings of Teatota *et al.* (1967) [30] in mango, Tandon and Kalra (1983) [24], Patil (1990), Patil (1996) [31], Datta and Dhua (2004) [4]. Among the maturity stage, higher level of non-reducing sugar T₁ i.e., kesar (10.88%) was recorded. The non-reducing sugar increased from the marble stage to the ripe stage and was significantly higher in kesar. Pandey *et al.* (1974) [15], Fuchs *et al.* (1980) [6], all observed a similar trend (1986). Among the maturity stage, higher level of total sugar T₁ i.e., kesar (17.16%) was recorded. The highest total sugars content of mango fruits was obtained T₁ when fruits harvested stage. These results are in line with Patil (1990) [19], Patil (1996) [31], Datta and Dhua (2004) [4]. The perusal of data revealed that TSS of fruit gradually increased. The highest TSS T₁ i.e., kesar (20.55°B) was registered. These findings are consistent with those of Mann *et al.* (1974) [13], Singh *et al.* (1976) [23], Tandon and Kalra (1983) [24], Obasi (2004) [14], Lechaudel and Joas (2006) [11], and Lucena *et al.* (2007) [12].

Table 1: Effect of heat unites in date of fruit maturity and heat unites in different varieties of mango

Treatment details	Heat unites required
T ₁ Kesar	1320.00
T ₂ Mallika	1526.00
T ₃ Neelum	1426.00
T ₄ Totapuri	1529.00
S.Em. ±	1.07
C.D.at 5%	3.43

Table 2: Effect of heat unit and time duration on physical parameters of fruit in different varieties of mango

Treatment details	Length of fruit (cm)	Length of stone (cm)
T ₁ Kesar	9.89	8.11
T ₂ Mallika	12.23	10.49
T ₃ Neelum	10.53	9.41
T ₄ Totapuri	12.65	11.18
S.Em. ±	0.13	0.10
C.D.at 5%	0.42	0.35

Treatment details	Breadth of fruit (cm)	Breadth of stone (cm)
T ₁ Kesar	6.38	3.36
T ₂ Mallika	7.51	4.18
T ₃ Neelum	7.23	4.21
T ₄ Totapuri	7.80	4.35
S.Em. ±	0.11	0.03
C.D.at 5%	0.35	0.11

Treatment details	Weight of fruit (gm)	Weight of pulp (gm)
T ₁ Kesar	271.75	211.14
T ₂ Mallika	298.75	230.58
T ₃ Neelum	253.73	190.44
T ₄ Totapuri	323.70	248.86
S.Em. ±	1.5584	1.6544
C.D.at 5%	4.9852	5.2923

Treatment details	Weight of peel (gm)	Weight of stone (gm)
T ₁ Kesar	18.40	42.21
T ₂ Mallika	18.15	49.85
T ₃ Neelum	24.29	40.58
T ₄ Totapuri	24.92	53.38
S.Em. ±	0.9531	0.5783
C.D.at 5%	3.04	1.85

Treatment details	Pulp: stone ratio
T ₁ Kesar	4.90
T ₂ Mallika	4.68
T ₃ Neelum	4.72
T ₄ Totapuri	4.79
S.Em. ±	0.0474
C.D.at 5%	0.1516

Table 3: Effect of heat unit and time duration on chemical parameters of fruits in different varieties of mango

Treatment details	T.S.S of ripening
T ₁ Kesar	20.55
T ₂ Mallika	19.38
T ₃ Neelum	17.35
T ₄ Totapuri	15.58
S.Em. ±	0.53
C.D.at 5%	1.72

Treatment details	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
T ₁ Kesar	6.28	10.88	17.16
T ₂ Mallika	6.06	9.77	15.82
T ₃ Neelum	4.18	10.14	14.04
T ₄ Totapuri	3.11	8.69	11.80
S.Em. ±	0.2676	0.3687	0.1759
C.D.at 5%	0.85	1.17	0.56

Treatment details	Titrateable acidity (%)
T ₁ Kesar	0.28
T ₂ Mallika	0.23
T ₃ Neelum	0.32
T ₄ Totapuri	0.26
S.Em. ±	0.0142
C.D.at 5%	0.0454

Conclusion

On the basis of the experiment conducted in the field it can be concluded that effect of heat unit and time period taken for maturity, significantly influenced physical parameters, quality parameter, time taken to maturity, different varieties of mango. Mango fruits harvested fruit set (T₁) with accumulation of 1320 HU was found to be the best. Fruits harvested at kesar better physical characteristics and quality parameters like TSS, minimum acidity, sugars, carotenoid content, which are more acceptable in the market.

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