Original Research Article

Determination of maturity indices for harvesting of ber (*Ziziphus mauritiana* Lamk.)

ABSTRACT

Indian jujube or ber (*Ziziphus mauritiana* Lamk.) is an important hardy underutilised fruit crop of arid and semi-arid regions of India, symbolizing the production at a minimal cost. Ber fruits are potent source of nutritional as well as medicinal values and are generally consumed as fresh. Ber fruits follow non-climacteric respiratory pattern. Fruits that are allowed to ripen on the tree typically have a limited shelf life and the ideal results are obtained if they are picked before the onset of ripening. Fruit harvesting at the appropriate stage of maturity is critical for both quality control and marketing. The time taken by ber fruit to mature from fruit set to maturity depends upon cultivar as well as location. Immature fruits lack desirable sweetness and flavour while over ripe fruits quickly lose their attractiveness and crispiness with slimy texture. Hence, an experiment was conducted to determine the optimum maturity indices for harvesting Indian jujube during 2019-20. Cultivar selected for this experiment was Narendra Ber Selection-2. The fruits on tagged current season shoots were harvested 21, 36, 51, 66, 81, 96, 111, 126, 141, 156, 171 and186 days after fruit setting. Fruit colour, shape, specific gravity, total soluble solids (%), T.S.S.: Acid ratio and organoleptic score of fruits were recorded at 15 days interval after fruit set.

Key words: *Indian jujube, maturity indices, specific gravity, total soluble solids, Organoleptic score.*

INTRODUCTION

Indian jujube or ber (*Ziziphus mauritiana* Lam.) is an important hardy underutilised fruit crop of arid and semi-arid regions of India *belongs* to the *rhamnaceae family.* Since ripe ber is typically consumed as fresh, they have significant potential for processed into diversified value-added products such as candy, syrup, squash and powder form (Pareek *et al.*, 2010). Indian jujubes are rich source of micronutrient (Fe) and macronutrient (Ca, K, P) including provitamin A, vitamin C and B complex. It can be widely cultivated and flourish even in the most marginal subtropical and tropical ecosystems (Pareek, 2001). It is native to area stretching from India to South Western China and Malaysia. Narendra Ber Selection-2 is late maturing cultivar yielding 12-14t/ha fruits per plant. Shelf life and quality of fruit can be improved by harvesting at appropriate maturity (Gupta and Kadam, 1995) Therefore, determination of maturity at harvest act as crucial factor that affects fruit quality and storage life. Immature fruits are more prone to shrivelling and mechanical damage, and have inferior quality on ripening whereas overripe fruits are likely to become soft, loose and mealy with an insipid flavour. Fruits harvested too soon or too late are more susceptible to physiological disorders and have limited storage life than fruits harvested at the appropriate maturity (Kader, A.A., 1999) and (Kader, A.A., 2002). Ber fruits have non-climacteric respiratory pattern. Fruits that are allowed to ripen on the tree often have a short shelf life, so it is essential to harvest prior to ripening (Al-Niami and Abbas, 1998) and (Al-Niami *et al.*, 1989). Determining maturity indices aids in ensuring nutritional and sensory quality (flavour, colour, aroma, and texture) ensuring an optimum shelf-life, facilitating harvest and packing operations. Therefore, it is crucial to harvest Indian jujube fruits at the right stage of maturity to ensure optimum market life of harvested fruits with better fruit quality. Hence, an experiment was conducted with the objective of determining the maturity indices for harvesting of Indian jujube.

MATERIALS AND METHODS

The experiment was conducted at Main Experiment Station, Department of Fruit Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India, during 2019-20. The 27 years old uniform vigorous ber trees of Narendra Ber Selection-2 were selected. The trees received uniform cultural operation throughout the experiment. The trial was laid out in a completely randomized design with four replications. The four fruits from each replication were randomly selected after fruit set regularly for physico-chemical analysis at 15 days interval. The specific gravity of four randomly selected fruits was computed by dividing the fresh weight of the fruits by volume of fruits and expressed in (g/cc). Total soluble solid (T.S.S.) of the juice was determined by using a hand Refractometer of 0-32 per cent range. The values were corrected at 20 ^{0}C and expressed as (^{0}Brix) T.S.S. of the fruit pulp (Ranganna, 2010). T.S.S.**:**acid ratio was determined by dividing the TSS with Titrable acidity. The fruit shape and colour were observed visually during fruit growth and development. Organoleptic test was conducted by the panel of five judges who tested the fruits on each sampling date. Samples were collected early in the morning and brought to the laboratory where they were tested immediately. The scoring was recorded by the judges. To present qualitative difference in taste quantitatively, to permit statistical analysis, the organoleptic quality was scored on the following 9.0-point Hedonic Rating scale (Amerine *et al.*, 1965). Mean taste of the four replicates as given by organoleptic score indicated in proforma, was calculated. The statistical analysis was carried out by following the standard procedure (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

Table -1: Changes in fruiting attributes to determine harvesting index for fruit harvesting.

Interval (days)		**Specific gravity**	**Fruit shape**	**Total Soluble Solids (%)**	**T.S.S.: Acid ratio**	**Fruit color**	**Organoleptic score**	**Rating**
21	**October**	1.07	ovate	1.04	2.67	Green	-	-
36		1.48	ovate	1.43	3.93	Green	-	-
51		2.45	ovate	1.50	4.57	Green	-	-
66	**November**	1.18	ovate	2.48	8.11	Green	-	-
81		1.16	ovate	2.98	12.06	Green	-	-
96	**December**	1.04	ovate	3.25	14.28	Green	-	-
111		1.01	ovate	4.38	24.15	Green	4	Neither like nor dislike
126	**January**	1.03	ovate	10.10	60.57	Green	6	Like slightly
141		1.02	ovate	15.05	95.10	Green	6	Like slightly
156	**February**	1.02	ovate	15.58	102.53	Lime green	7	Like Moderately
171		0.95	ovate	17.29	123.72	Yellowish green	7.5	Like Moderately
186	**March**	0.92	ovate	17.94	128.37	Yellowish green	8	Like very much

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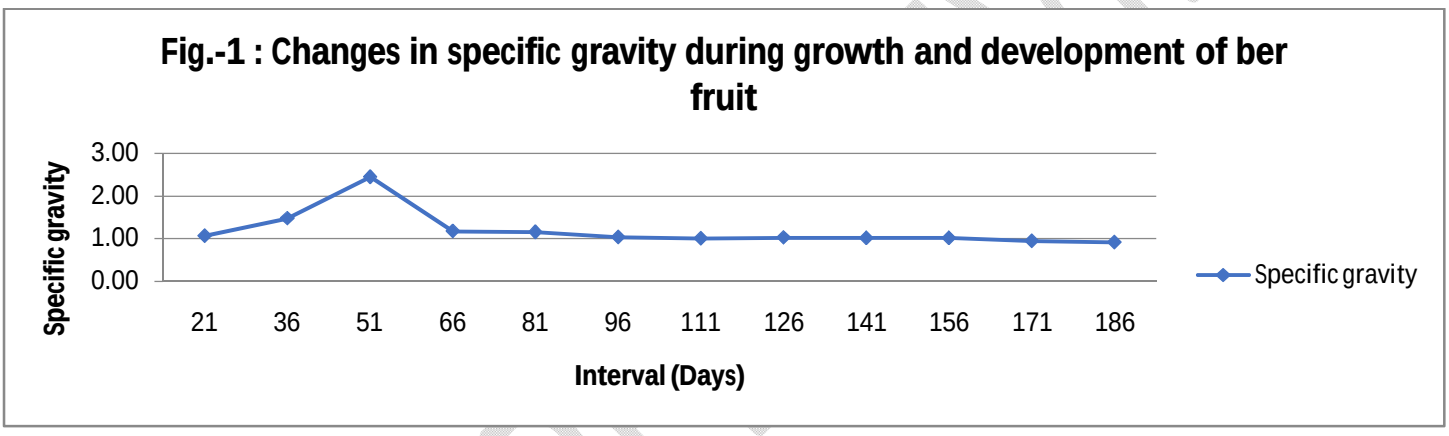
SEm±	**0.23**		**0.11**	**1.07**		**0.06**	
CD at 5%	**0.67**		**0.34**	**0.34**		**0.18**	

Specific gravity

The data pertaining to specific gravity of various stages of fruit growth and development are presented in Table-1 and showed pictorially in Fig. 1. The maximum specific gravity of fruits was observed 2.45 at 51 days which gradually decreased to 0.92 at 186 days after fruit set. The accumulation of more metabolites and higher weight gain at faster rate than increase in volume may be the causes of the increase in specific gravity. This is consistent with those of Meel *et al.*, (1991) and Pandey *et al.*, (2019) who recommended that fruits should have a specific gravity less than 1 for harvest maturity.



Shape

Shape of ber fruit cv. NBS-2 was observed ovate in all the stages of fruit growth and development. Similar observation was recorded by Godi *et al*., (2016).

Total Soluble Solids

Total Soluble Solids [Table 1; Fig.-2] manifested an increasing trend during the fruit growth and development and 17.94% was recorded at harvest maturity (186th days). An increase in total soluble solids is the outcome of the hydrolysis of polysaccharides into sugar and the synthesis of other water solubles. This is in agreement with the study by Daulta and Chauhan, (1982) who reported that T.S.S. at maturity is about 18% in cv. Kaithli.

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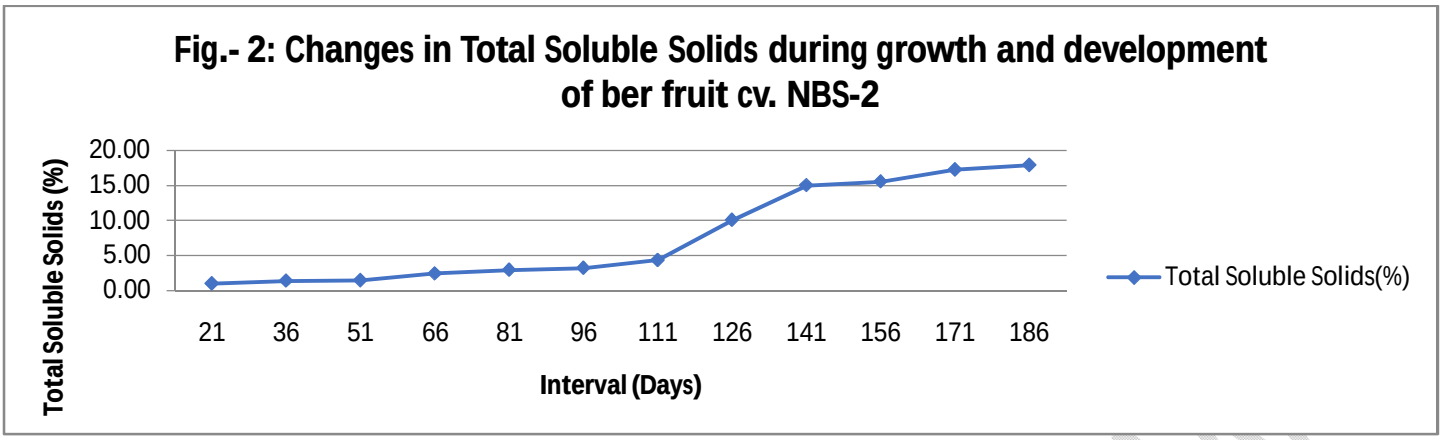
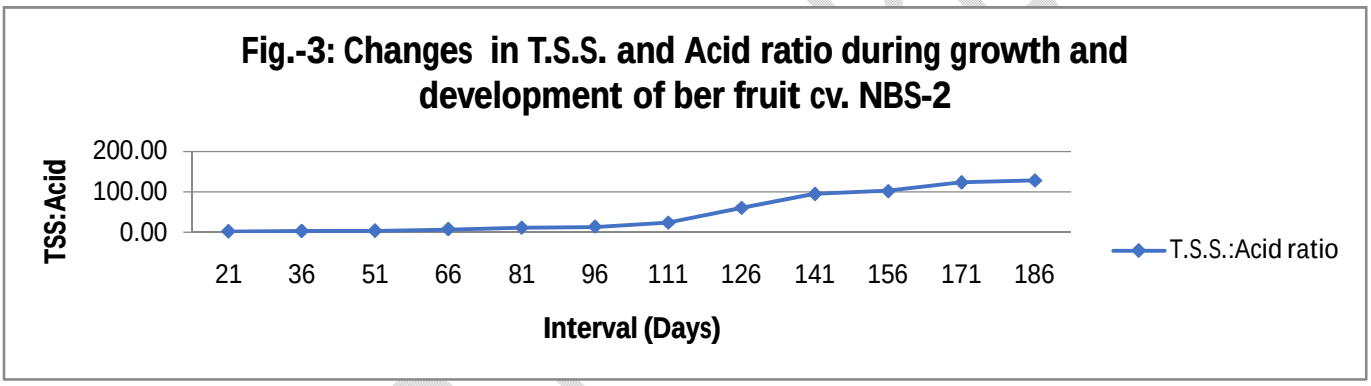


T.S.S.: Acid ratio

The T.S.S.: Acid ratio showing increasing trend from fruit set till maturity and at maturity the value was 128.37 (186 days). This is in corroboration with the findings of Bhatia and Gupta (1985) who narrated that T.S.S.: acid ratio at maturity should be 93-100 for ber cv. Umran. Meel, O.P. and Chharia, A.S. (1987) observed value 128.10. T.S.S.: acid ratio at maturity for ber cv. Mundia Murahara.



Colour

Fruit colour at maturity was observed yellowish green during onset of ripening that is at an interval (days) of 171 to 186. The results are in line with the findings of Singh *et al.* (1981), Siddiqui and Gupta, (1989), and Al-Niami *et al.* (1992).

Organoleptic score

A perusal of data (Table-1) revealed that organoleptic quality of fruit according to 9-Point Hedonic Scale showed qualitative change and influencing taste of fruits from starting to end of observations. The changes in organoleptic score indicates that fruits edible acceptance was increased as fruits proceeded towards maturity and fruit attained 7-5 and 8.0 score on 171 and 186 days after fruit setting, respectively. The more than 7 score shows that fruit possess edible quality on 171 days after fruit setting onward (Fig. 4) and can be used for processing and table purpose. The results are in line with the findings of Islam *et al.* (2015).

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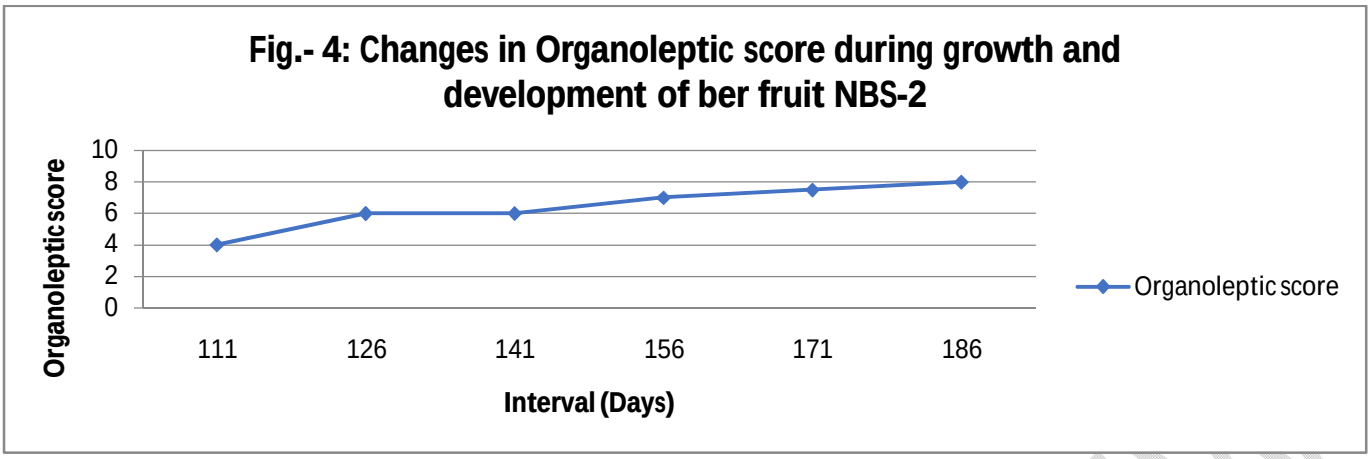

CONCLUSION

Specific gravity, fruit shape, colour, total soluble solids (%), T.S.S.: Acid ratio and organoleptic score of Narendra ber selection-2 used as recommended physical, biochemical or sensory attributes to determine optimum maturity indices for harvesting at appropriate time

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