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Fruit Growth of China Cherry (*Muntingia calabura*)

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Abstract: Morphological and growth characteristics of flower and fruit of China cherry (*Muntingia calabura*) were investigated to ascertain harvest maturity at Mymensingh (24°26′ and 24°54′ N and 90°15′ and 90°30′ E) in 2008. Flowers were tagged at anthesis and fruit growth was investigated at different ages (days after tagging, DAT). All the morphological characters of fruits were gradually increased with increasing DAT. The length and diameter reached the maximum (0.99 and 1.17 cm for length and diameter, respectively) about 53 DAT. The fresh and dry weights of fruits were also reached the maximum at 53 DAT. Proximate composition of fruit (at three stages of growth, 15, 35 and 53 DAT) and matured leaf were determined. Ash (4.69%), crude fibre (13.88%), crude protein (7.81%) and crude fat (5.70%) contents of fruits were lower but the total organic matter (95.30%) and nitrogen free extract (67.89%) contents were higher in ripe berries (53 DAT) than the other stages. The leaf also contained 7.40% ash, 27.31% crude fibre, 16.25% crude protein and 7.72% crude fat. Results concluded that harvest maturity was attained around 53 DAT for China Cherry when the deep green berries turn to yellowish pink with an average fruit weight of 1.42g.

Key words: Maturity · Growth Nutrient composition · *Muntingia calabura*

INTRODUCTION

China Ccherry (*Muntingia calabura* L.) is a minor but well-known as tropical and edible fruit belongs to Muntingiaceae [1]. It is a very fast-growing tree, reaching 25 to 40 ft in height, with spreading, nearly horizontal branches. The leaves are evergreen, alternate, lanceolate or oblong, long-pointed at the apex, oblique at the base. The flowers are hermaphrodite borne singly or in cluster of 2's or 3's in the leaf axils with 1.25 to 2 cm wide,5 green sepals and 5 white petals and many prominent yellow stamens [2]. A 100 g edible portion of the berries contain approximately 76.3 g water, 2.1 g protein, 2.3 g fat, 17.9 g carbohydrates, 6.0 g fiber, 1.4 g ash, 125 mg calcium, 94 mg phosphorus, 0.015 mg vitamin A, 90 mg vitamin C. The energy value is 380 kJ/100 g [3]. Ripened fruits are used into jams and used in tarts. Because of its ability to grow quickly on poor soils and rapid dispersal by birds and bats, the cherry tree is being considered as a candidate for reforestation for environmental protections. Although the plants bear fruits throughout the year, he peak flowering and fruiting season is mainly from April to July. During the peak fruiting season berries turn red as indicating maturity (ripening). The ripened fruit respire and transpire resulting in weight loss and become softened. Further, the berry drops as soon as it reaches maturity. The ripened berries cannot be stored more than a couple of days. Harvesting fruits even before ripening stage may be safer but certainly yield will be decreased. For commercial cultivation fruits must be harvested before ripening, so that fruit could be stored for certain days or be transported to a distant place in a cool chamber for sale and uses. Harvest time is the most important factor that determines the storage life and final fruit quality. Any fruit picked either too early or too late is more susceptible to physiological disorders and has a shorter storage life than fruit picked at the proper maturity [4]. There is no published information about growth and nutrient composition of China cherry fruit and needs to investigate the right harvesting stage. So, the present study was undertaken (i) to investigate the growth of fruit; and (ii) to determine the nutritional value of the fruit. Overall objective was to ascertain the right stage of fruit harvest.

MATERIALS AND METHODS

Six China cherry plant of 3-4 year age were considered for the study in Botanical Garden, Bangladesh

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Agricultural University, Mymensingh (24°26' and 24°54' N and 90°15' and 90°30' E) between April to July in 2008. Flowers were tagged with different coloured woolen threads (red, yellow, green, white, pink etc.) were loosely fastened in the pedicel of flowers at anthesis. To study the growth of fruit, the fruits were randomly harvested from the tagged flowers at 0, 7, 15, 20, 25, 35, 45, 53 and 55 days after tagging (DAT). At each age (DAT), at least 20 fruits were collected in each group. At each DAT, length, diameter, fresh weight and dry weights of the fruits were recorded. The length and diameter of fruits were measured with the help of threads and ruler. The fresh weight of fruit was recorded and the samples were oven dried at 80±2°C for 72 hours to obtain corresponding dry weights. Total soluble solid (TSS) content in fruit was measured by using Refractometer at each stage. The Absolute Growth Rate (AGR) of fruit was calculated using the following formulae, AGR (g/day) = $\frac{W2-W1}{T2-T1}$, where, W_1 and W_2 are the dry mater (DM) at T_1 and T_2 days, respectively. The proximate constituents; Crude protein (CP), Ether extract (EE), Crude fibre (CF), Total Ash (TA) and Nitrogen free extracts (NFE) were determined according to conventional method [5]. The photographs were taken using digital camera (Coopix, Nikon Corporation, Japan). The completely randomized design (CRD) was followed with four replications. Data obtained from chemical analyses were also compiled following same procedure with three replications. Computer software SPSS was used to analyze the data. The mean differences were compared by least significant difference (LSD) test [6].

RESULTS

Fruit Length and Diameter: Generally, fruit length and diameter followed a double sigmoid pattern (Fig. 1A). The length was 0.187 cm at 0 DAT and grew rapidly and linearly and reached 0.635 cm at 15 DAT followed by a plateau between 25 and 35 DAT and then again grew linearly but slowly and reached to approximately 1.0 cm followed by plateau between 53 and 55 DAT. Fruit diameter followed a trend also similar to that of fruit length (Fig. 1A) (Plate 1).

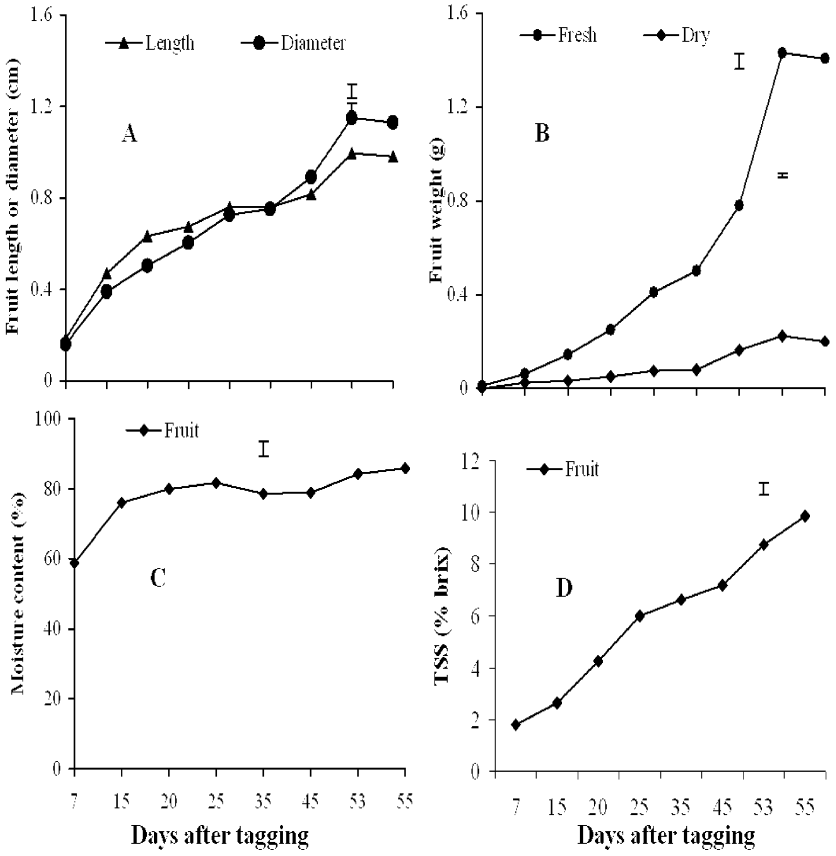

Fig. 1: Changes in fruit size and TSS content: (A) fruit length and diameter; (B) fruit fresh and dry weight (C) moisture content; and(D) TSS content at different ages (days after tagging, DAT) in China cherry. Vertical bars are $Lsd_{0.05}$

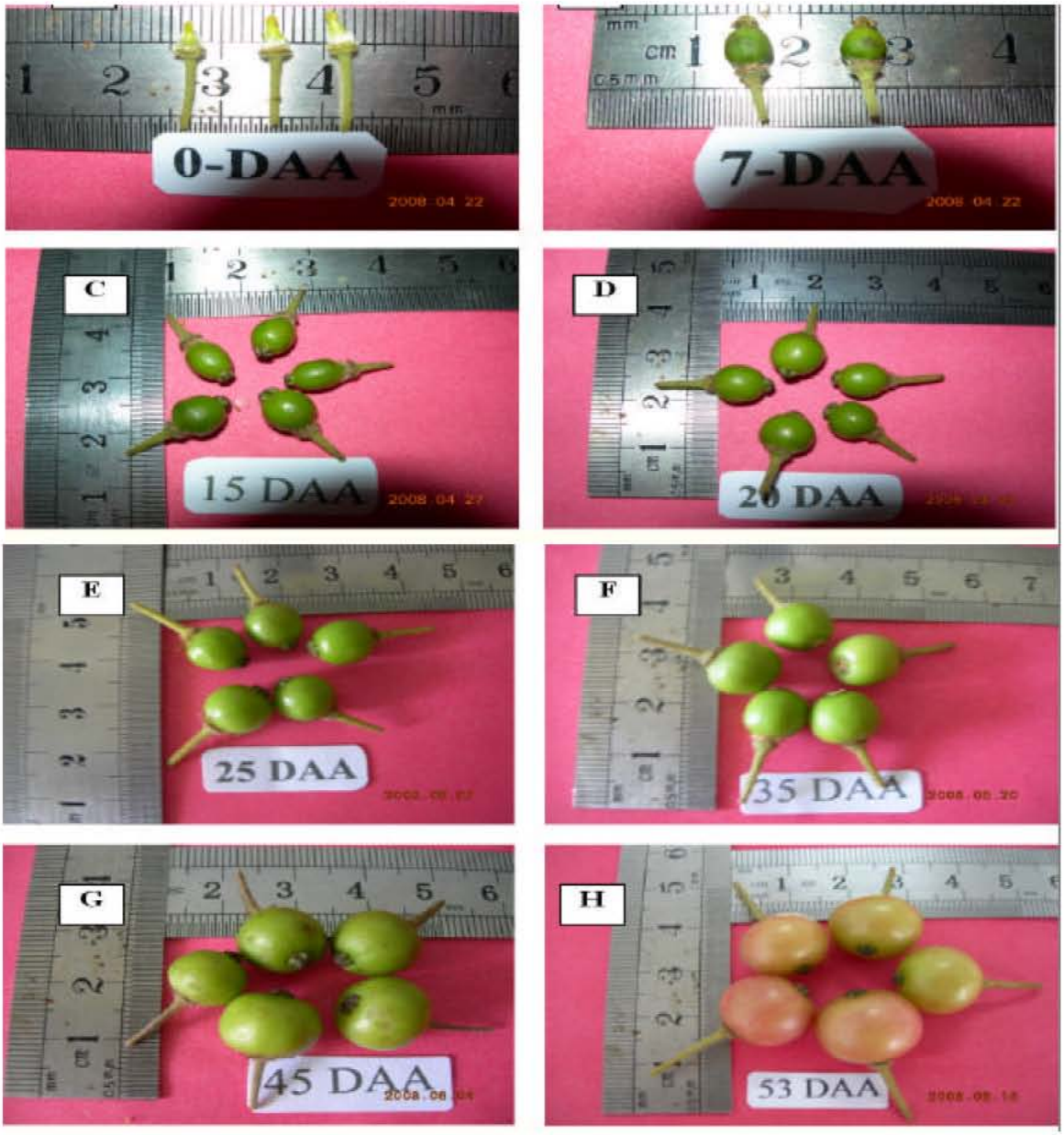

Plate 1: Changes in fruit size of China cherry at different ages (days after tagging, DAT): (A) 0 DAT; (B) 7 DAT; (C) 15 DAT; (D) 20 DAT; (E) 25 DAT; (F) 35 DAT; (G) 45 DAT; and (H) Seed

Fresh and Dry Weight of Fruit: Fresh weight of fruit followed a sigmoid pattern (Fig. 1B). The fresh weight of fruit was low at 0 DAT and increased linearly but slowly up to 0.50 g at 35 DAT and grew sharply to 1.42 g at 53 DAT followed by a plateau between 53 and 55 DAT. The dry weight was very low at early stage and increased gradually to 0.224g/fruit at 53 DAT.

Moisture and TSS Content: Generally, moisture and TSS content in fruit increased with increases ages (DAT) (Fig. 1C, D). The moisture content was 58.81 % at 7 DAT and became 79.90 % at 20 DAT and remained stable up to 45 DAT followed by a maximum at 55 DAT (Fig. 1C). TSS content in fruit was 1.8 % brix at 7 DAT and increased rapidly and linearly and remained almost unchanged till maturity (Fig. 1D). The maximum TSS content (9.85 % brix) in fruit was found at ripening state (55 DAT).

Absolute Growth Rate (AGR): Effect of ages (days after tagging, DAT) on AGR of fruit was significant (P=0.05)

Table 1: Variation in absolute growth rate (AGR) of fruit in China cherry at different ages (days after tagging, DAT)

Age (DAA)	AGR (g/day)
0-7	0.0035b
7-15	0.0011bc
15-20	0.0032b
20-25	0.0050ab
25-35	0.0005c
35-45	0.0084a
45-53	0.0075a
55-53	-0.0012c
$LSD_{0.05}$	0.0039

In each column, figures bearing uncommon letter(s) are significantly differ at P=0.05 by DMRT. Each figure is the mean of 20 fruit (5 fruit × 4 reps).

Table 2: Changes in proximate composition of fruits in China cherry at different ages (days after tagging, DAT)

	Proximate composition of fruits					
Age (DAT)	Ash (%)	Crude fiber (%)	Crude protein (%)	Crude fat (%)	Total organic matter (%)	Nitrogen free extract (%)
15	7.51a	19.40b	10.66b	3.74c	92.48b	58.67b
35	7.71a	25.13a	11.88a	7.10a	92.28b	48.17c
53	4.69b	13.88c	7.81c	5.70b	95.30a	67.89a
$Lsd_{0.05}$	0.212	3.31	0.519	0.811	0.212	3.059

Table 3: Proximate composition of fully matured green leaves of China cherry

	Proximate composition of leaves					
	Ash (%)	Crude fiber (%)	Crude protein (%)	Crude fat (%)	Total organic matter (%)	Nitrogen free extract (%)
Mean	7.40	27.31	16.25	7.72	92.6	41.31
s.e.m	±0.035	±0.466	±0.19	±0.028	±0.035	±1.13

(Table 1). The AGR of fruit was significantly greater between 20-25 DAT and also between 35 and 53 DAT (average of 0.0069 g/day) than the others. The AGR became negative when the fruit ripened.

Proximate Composition of Fruits: The proximate composition of the fruit varied significantly (P=0.05) at different ages (days after tagging, DAT) (Table 2). Ash content at 53 DAT (ripe fruits) was lower (4.69%) than 15 and 35 DAT (average of 7.61%). Crude fiber content of the fruits was greater at 35 DAT (25.13%) than 15 (19.40%) and 53 DAT (average of 13.88%). Crude protein content of the fruits also reached the maximum at 35 DAT (11.88%) and was greater than 15 (10.66%) and 53 DAT (7.81%). Crude fat was also higher at 35 DAT (7.10%) than 53 (5.70%) and 15 DAT (3.74%). The organic matter content of the fruit reached the maximum (95.30%) at 53 DAT than 15 and 35 DAT (average of 92.38%). Nitrogen free extracts recorded also maximum at 53 DAT (67.89%) than 15 (58.67%) and 35 DAT (48.17%) (Table 2).

Proximate Composition of Leaves: Leaves of China cherry also contained considerable amount of ash, crude fiber, crude protein and nitrogen free extracts. A 100g dry weight of mature green leaves of China cherry contained 7.40g ash, 27.31g crude fibre, 16.25g crude protein, 7.72g crude fats and 41.31g nitrogen free extracts (Table 3). The total organic matter content of the leaves was found 92.6% of its weight.

DISCUSSION

China Cherry is an important fruits and widely cultivated in India, Southeast Asia, Malaya, Indonesia and Philippines [1]. Fruit length and diameter became greater (0.99 cm and 1.17 cm, respectively) at 53 days after tagging (DAT) and remained more or less unchanged till 55 DAT, also indicating maximum fruit size at maturity stage (Fig. 1A). This signifies that when the berry reaches approximately 1.0 cm in length or 1.17 cm in diameter, berries could be harvested. The edible part of the fleshy

fruit is juicy pulp. The fruit fresh and dry weight also reached peaked (1.42 and 0.224g/fruit, respectively) at 53 DAT (Fig. 1B) that again suggest the harvesting stage of this fruit. Rahman *at al.* [7] also reported that China cherry attained harvest maturity around 53 and 55 days after flowering (DAT) when the fruit weigh 1.3 -1.5 g and the length or diameter around 1.0-1.20 cm. Total soluble solid (TSS) content of berry increased linearly and reached the maximum at maturity (*c.* 10 % brix) (Fig. 1D) indicating the harvesting time. Kader [4] suggests that the optimum time for harvesting common cherry in California region is at the time when soluble solid content varied between 14 and 16 %. The variation of TSS between the results might be due to different varieties and/or species and may be due to different climatic conditions. The ash, crude fiber, crude protein and crude fat were lower but the total organic matter and nitrogen free extracts were higher in the ripe fruits. Fiber, protein and fat in fruit may be gradually degraded and converted to organic substances and sugar. Var and Ayaz [8] reported that the fructose and glucose content in fruits of cherry laurel (*Laurocerasus officinalis*) was lower between 23 and 58 days after flowering (DAF) and increased between 65 and 86 DAF. Upreti and Shrestha [9] reported that Crude protein, neutral detergent fiber (NDF) and energy content is negatively related with the maturity in legumes and grains. Leaf of this species also rich in protein (16.25%) content and can be used as fodder. The initial elongated oval shape of immature fruit changed to round at harvest maturity. Texture of the fruit remained smooth during the period of growth. Around at 2 months age from DAT, a berry of China cherry turn from deep green to yellow or red/pink colour indicating visual index of fruit harvest. These indices are partially important because the berries of China cherry start abscising near harvest maturity. Fruits of this plants are, therefore, should be harvested around/prior to maturity.

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