

## Fruit growth in Dephal (*Garcinia xanthochymus*)

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**Abstract:** To assess harvest maturity of Dephal (*Garcinia xanthochymus* Hook. f.) morphological features and growth characteristics of fruits and seeds was investigated at Mymensingh (24°26' & 24°54' N and 90°15' & 90°30' E). Flowers were tagged at opening and fruit growth was investigated at 3, 7, 10, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98, 105 and 112 days after flowering. All the morphological characters of fruits were gradually increased with increasing ages (days after flowering, DAF). The highest value (around 5-7 cm) of length and diameter of Dephal was observed around 112 DAF. Fresh weight of fruit reached maximum between 105 and 112 DAF (approximately 106-118 g/fruit). Results indicate that harvest maturity was attained around 112 DAF when fruit size was 5-7 cm with fruit weight 106-118g.

**Key words:** *Garcinia xanthochymus*, Morphology, Fruit growth, Maturity.

### Introduction

In the tropics and subtropics 'Dephal' (*G. xanthochymus* Hook. f.) is an important fruit trees, belong to the family Guttiferae. Dephal is most frequently called dem-gola, aruak (Das and Alam, 2001). Propagation is mainly by seed. *Garcinia* is native to the Malay-Archipelago and the Molucca and Sunda Island. In Bangladesh, it occurs in the forest of Chitagong, Cox's Bazar, Comilla, Chittagong Hill Tracts and Sylhet and is usually grown in clayey moist soil (Das and Alam, 2001). The genera *Garcinia* is widely used as a source of edible fruits, timber, resin, drug and various other natural products. Apart from the aril being consumed as a dessert fruit, the dried fruit rind, which contains tannin and xanthenes is used as native anti-inflammatory and antidiarrhoeal medicine and for treatment of dysentery (Yapwattanaphun *et al.*, 2002). Young shoot and the mature fruit of Dephal are eaten as vegetable and edible fruits (Yapwattanaphun *et al.*, 2002). Seed oil of Dephal has a fatty content of 5 to 23%. Iodine and acid value were (82.3 and 35.3) in Dephal (Kotoky *et al.*, 2001). Wood of Dephal is yellowish-brown, fine textured, hard and heavy and said to be suitable for textile shuttles (Granja-e-Barros, 2002). The fruit is extremely acidic in taste. The fruits of depthal turn deep green to light green with a patch of yellow/red colour when reaches maturity. The fruits droop naturally at maturity resulting the physical injury of fruits. Fruit quality and storage duration greatly influenced by harvesting time. Harvesting fruits even before ripening stage may be safer but certainly yield will be decreased. Therefore, the fruit should be harvested at proper stage of maturity. Physiological maturity is important to preserve seed and to obtain high percentage of seed germination. There is little literature on morphological features (Das and Alam, 2001) and only one report (Roy, 2007) on fruit growth of Dephal in Bangladesh. But it is necessary to identify the stage of maturity or ripening stage of those fruits. Therefore, the present study was conducted to investigate fruit growth in terms of increment of length, diameter, weight and absolute growth rate.

### Materials and Methods

The investigation was conducted at the Botanical Garden, Bangladesh Agricultural University, Mymensingh (24°26' and 24°54' N and 90°15' & 90°30' E) during the period from April to September, 2008. Data on different morphological characteristics of fruits were recorded.

Samples from selected plants were collected beginning from the flowering to till maturity. Flowers were tagged in the hermaphrodite plant of Dephal. The tagged fruits were harvested at 3, 7, 10, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98, 105 and 112 DAF. At each time (DAF) 25 fruits were collected and divided into five group representing 5 replications consisting five fruits in each group. Freshly harvested fruits were shelled and the seeds were separated. Length, diameter, Fresh & dry weight of pericarp, seed and fruit (pericarp and seed) were recorded at each age. The samples were dried in oven at 70-80°C for 72 hours and their corresponding dry weight were recorded. Eighteen durations (DAF) of data collection were used as 18 treatments. The completely randomized design (CRD) was followed with five replications. The programme MSTAT (Russel, 1986) was used to analyse the data. Analyses of variances of different parameters were performed by 'F' variance test. The mean of different parameters were compared by least significant difference (LSD) test as described by Gomez and Gomez (1984).

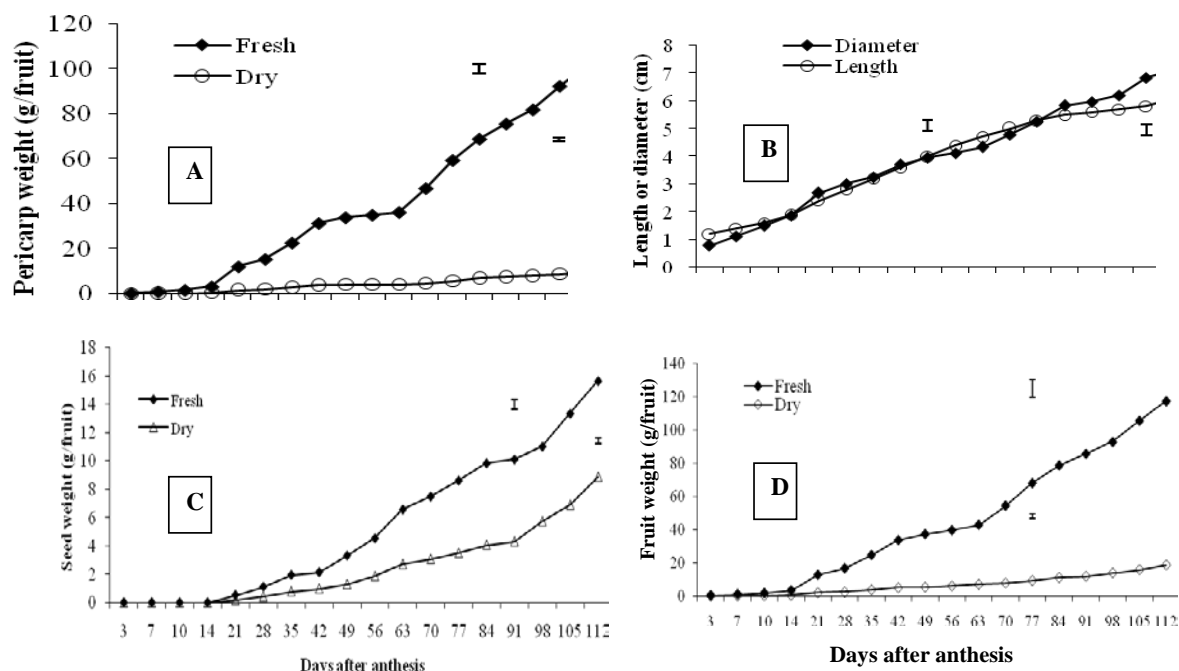
### Results

**Fruit length and diameter:** The growth of fruit length followed a linear pattern (Fig. 1A). The fruit length was 1.20 cm at 3 days after flowering (DAF) and the rate of growth was progressively increased and remained almost unchanged till maturity. The maximum fruit length (around 5.95 cm) was obtained between 105 and 112 DAF (Fig. 2A). Almost similar trend was found in case of Fruit diameter (Fig 1A).

**Fresh and dry weight of pericarp and seed:** The changes of fresh and dry weight of pericarp, seed and fruit varied significantly ( $O \leq 0.05$ ) at different days after flowering (DAF) (Fig. 1B-D). Both fresh weight of pericarp and seed followed an exponential pattern (Fig. 1B, C). Generally, pericarp fresh weight increased slowly up to 14 DAF followed by a rapid and linear increase up to 35 DAF. Between 42 and 63 DAF, fresh weight of pericarp attained almost a uniform growth (34.15 g/fruit) and there after gradually increased up to 112 DAF. Dry weight of pericarp followed a linear pattern of growth (Fig. 1B). The lowest dry weight of pericarp was observed 0.05 g at 3 DAF and became maximum at 112 DAF (9.76 g/fruit). Visible seeds were observed at 14 DAF (Fig. 2C). There was very little fresh weight of seed (0.54 g/fruit) at 21 DAF and grew rapidly and linearly up to 42 DAF and followed by a increasing trend similar to that of pericarp

fresh weight. Seed dry weight also followed an exponential pattern (Fig. 1C). Dry weight of seed was very little (0.19g) at 21 DAF and increased with increase ages (DAF). It became 0.89 g between 35 and 42 DAF and grew rapidly reaching maximum (8.91g) at 112 DAF (Fig. 1C). Total fresh and dry weight of fruit (pericarp with seed) at different ages (DAF) is represented in the Fig. 1D. The pattern of increase in fresh and dry weight of fruit was

similar to that of pericarp fresh and dry weight (Fig. 1B). Total fresh weight of fruit was around 0.92 g between 3 and 10 DAF and increased with increasing the ages (DAF). It grew rapidly and linearly up to 112 DAF (117.57 g/fruit) (Fig. 1D). The dry weight of fruit increased slowly for the first 21 DAF (around 0.25 g/fruit) followed by a linear increase with increasing of age. It became maximum at 112 DAF (20 g/fruit).



**Fig. 1.** Changes in fruit length and diameter (A), pericarp fresh and dry weight (B), seed fresh and dry weight (C), and fruit fresh and dry weight (D) at different ages (days after flowering, DAF) in Dephal. Vertical bars are Lsd<sub>0.05</sub>.

**Absolute growth rate (AGR):** Effect of ages on AGR of pericarp, seed and fruit was significant (Table 1). AGR of seed and fruit increased with increasing ages (DAF) and reached maximum between 105 and 112 DAF (0.282 and 0.401 for seed and fruit respectively). AGR of pericarp become significantly greater (0.175  $\text{gd}^{-1}$ ) between 77 and 84 DAF than between 70 and 77 DAF (0.15  $\text{gd}^{-1}$ ) and others. AGR of seed become significantly greater (0.282  $\text{gd}^{-1}$ ) between 105 and 112 DAF than between 91 and 98 DAF (0.202  $\text{gd}^{-1}$ ), between 98 and 105 days (0.168  $\text{gd}^{-1}$ ). AGR of fruit followed more or less similar trend of seed.

**Moisture content and pulp to fruit ratio:** Moisture content in pericarp increased with increasing ages (DAF) but that of in seed showed a reversed trend (Table 2). Moisture content in pericarp was smaller (73.08%) at early stage (3 DAF) and increased with increasing ages (DAF) and reached maximum (90.42%) at around 112 DAF but in case of seed it was decreased with increasing the ages. It was highest at 21 DAF (64.81%) and down to 59.16% at 49 DAF and lowest (43.13%) at 112 DAF (Table 2). Pulp to fruit ratio followed a trend also similar to that of moisture content in seed. Pulp to fruit ratio was maximum (1.00) between 3 and 14 DAF and then declined between 21 and 49 DAF (around 0.93) and further decreased drastically in the latter stage (Table 2). The lowest pulp to

fruit ratio was observed between 105 and 112 DAF (around 0.85).

### Discussion

Dephal (*Garcinia xanthochymus*) is reported to be grown around Madhupur region of Bangladesh. Young shoot and the mature fruits are eaten as vegetable and edible fruits in Thailand (Yapwattanaphum *et al.*, 2002). Locally juices of yellow ripe fruits are reported to be used as drink or soup in Bangladesh. Evergreen canopy has a very high aesthetic value. Fruit growth was investigated by measuring length, diameter and weight (fresh and dry) beginning from fruit set (to anthesis) to full maturity. Fruits of Dephal required much longer time to mature (112 DAF). Fruit length and diameter become greater (5-7 cm) at 112 DAF (Fig. 1A). This signifies that when a fruit of Dephal reaches to approximately 5-7 cm in length or diameter, fruit could be harvested. The current result is similar with the report of Das and Alam (2001) who also noted that berry of Dephal was 5.0 cm in diameter. The pericarp fresh weight reached maximum at 112 DAF (Fig. 1B). Seed fresh weight and dry weight continue to increase at 112 DAF. Which again suggest the harvesting stage of fruit. Fruit (pericarp with seed) also showed maximum fresh and dry weight at 112 DAF. Maximum fruit growth at 112 DAF was further evidenced by peak absolute growth rate of fruit at this time

(Table 2). The moisture content of the fruits gradually increased and the fruit become soft and juicy when riped. All these results suggest that fruit of Dephal mature

around 112 DAF. After 3 months from flowering, a fruit of Dephal turn deep green to light green and then light yellow indicating visual index of fruit harvest.

**Table 1.** Variation in absolute growth rate (AGR) in Dephal at different ages (days after flowering, DAF)

Age (DAF)	AGR (gd <sup>-1</sup> )		
	Pericarp	Seed <sup>†</sup>	Fruit
3-7	0.025 h	-	0.025 i
7-10	0.040 fg	-	0.040 hi
10-14	0.050 fg	-	0.050 hi
14-21	0.018 h	0.027 g	0.210 d
21-28	0.027 gh	0.034 fg	0.061 h
28-35	0.138 c	0.051 ef	0.190 de
35-42	0.148 bc	0.028 g	0.177 e
42-49	0.014 h	0.045 fg	0.060 h
49-56	0.014 h	0.081 e	0.095 g
56-63	0.015 h	0.120 d	0.135 f
63-70	0.061 ef	0.052 ef	0.114 fg
70-77	0.150 ab	0.061 ef	0.211 d
77-84	0.175 a	0.081 e	0.257 c
84-91	0.074 ef	0.034 fg	0.108 fg
91-98	0.090 de	0.202 b	0.292 b
98-105	0.115 cd	0.168 c	0.284 bc
105-112	0.118 cd	0.282 a	0.401 a
Lsd <sub>0.05</sub>	0.032	0.028	0.030

In each row, figures bearing uncommon letter(s) are significantly different at p≤0.05 by DMRT. †: Seeds were visible to naked eyes at 21 DAF, each figure is the mean of 25 (5 fruits × 5 reps) fruits.

**Table 2.** Moisture content, pulp to fruit ratio at different ages (days after flowering, DAF) in Dephal

Parameter	Ages (DAF)																	Lsd <sub>0.05</sub>	
	3	7	10	14	21	28	35	42	49	56	63	70	77	84	91	98	105		112
Moisture Pericarp (%)	73.08d	83.22c	83.33c	85.13bc	85.51bc	87.2ab	87.41ab	87.41ab	88.05ab	88.15ab	88.25ab	89.89a	90a	90.08a	90.09a	90.33a	90.33a	90.42a	2.751
Seed <sup>†</sup>	-	-	-	-	64.81a	61.6b	60.54bc	59.48bc	59.16bc	58.85cd	58.66cd	58.59cd	58.43cd	57.25d	53.95e	50.5f	48.12f	43.13g	2.421
Pulp: Fruit	1.0a	1.0a	1.0a	1.0a	0.96b	0.94ab	0.93ab	0.92ab	0.91ab	0.88bc	0.88bc	0.88bc	0.88bc	0.87bc	0.87bc	0.87bc	0.86c	0.85c	0.079

In each row, figures bearing uncommon letter(s) are significantly different at p≤0.05 by DMRT. †: Seeds were visible to naked eyes at 21 DAF

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