



Seed maturity indices in *Aisandra butyracea* - A multipurpose tree species of lower Himalaya

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Abstract: Fruits of *Aisandra butyracea* (Roxb.) Lamb. were collected from two sites located at different altitudes in Kumaun Himalaya for analyzing the seed maturity in relation to various fruit and seed characters. The mean seed size (length × width) across the collection dates varied between 186.44 ± 0.05 and 238.17 ± 0.5 mm² across both the elevations. The fruit colour changed from dark green in the beginning to pale yellow on the maturity. The range of seed moisture content (62.83 ± 1.33 to $63.46 \pm 0.89\%$) coincided with maximum germination. The colour change and seed moisture content appear to be the major indicators of seed maturation in *A. butyracea*.

Key words: Germination, Seed maturity, Seed moisture content, *Aisandra butyracea*
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Introduction

Aisandra butyracea (Roxb.) Lamb. (Indian butter tree) of the family Sapotaceae is an under exploited multipurpose tree which is locally known as Cheura. The species occurs in the Sub-Himalayan tract and in the outer Himalayas from Kumaun eastwards to Sikkim and Bhutan between 400 and 1700 m altitude. It is a fast growing species which is found mainly along the sides of ravines in hills and in shady valleys. In north India, it flowers in October-November and fruits ripen in June- July (Troup, 1921). It is a potential tree for fodder. The fruits of this species are used as valuable staple food, and the flowers constitute forage for bees during winter months. The seeds of *A. butyracea* yield edible oil known in the trade as "Phulwara butter".

Collection time of fruits of *A. butyracea* is important as seeds have viability of approximately 2 weeks and both over mature and under mature fruit have low germination. Seed maturation in many tree species is often accompanied by recognizable changes in size, colour, taste, odour and texture of the fruit and seeds (Krugman and Jenkinson, 1974). In certain species maximum seed quality is achieved when seeds reach maximum dry weight (Harrington, 1972). However, in certain other species maximum seed quality is reached some time after attaining maximum dry weight (Demir and Ellis, 1992). While numerous studies have been made on various aspects of *Madhuca latifolia* a close relative of *A. butyracea*, (Vanangamudi and Palanisamy, 1989), information on maturation indices of *A. butyracea* is limited. In this study collection of *A. butyracea* fruits were made over 35-day period from two sites varying in elevation by approximately 1000 m to develop seed maturation indices for better regeneration and multiplication of the species in nursery. Since the species has limited viability information on exact time of its seed maturation is essential for its multiplication.

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Materials and Methods

Fruits of *A. butyracea* were collected from 5 average sized healthy trees each located at Syat (380 m) and Dhuhani (1300 m) in Nainital district of Kumaun Himalaya. The tree height across the selected trees ranged between 16.5 and 24 m and mean diameter between 18.0 and 28.0 cm at Syat site where as, at Dhuhani the tree height ranged between 18.5 and 23.4 m and tree diameters between 21.3 and 28.5 cm. At Syat the associated species were *Shorea robusta*, *Grewia optiva* and *Mallotus phillipensis*, while at the other site Dhuhani the associated species were *Aegle marmelos* and *Terminalia tomentosa*. Mean maximum temperature at Syat was 41.6°C and at Dhuhani 36°C and mean relative humidity ranged from 59.5 to 74.9% at Syat and 63.5 to 77.2% at Dhuhani during the collection period.

Collection work of fruit began from 20th May 2001 from both sites and continued till 22nd June, at the intervals of 4 days. A total of 20 fruits in five replicates were used to determine the fruit size from each site. Number of fruits 100 gm⁻¹ and weight of 100 fruits were also recorded using five replicates. The fruits in the laboratory were hand squeezed for seed extraction. The seeds were washed under running water and thoroughly cleaned. The length and diameter of 20 seeds, number of seeds 100 gm⁻¹ and weight of 100 seeds were also recorded for each site using 5 replicates.

Seed moisture content (MC%) expressed on a fresh weight (FW) basis, was determined for each collection date using three replications of 100gms seeds dried at $103 \pm 2^\circ\text{C}$ for 16 ± 1 hr (ISTA, 1981) and then weighed. Moisture content was calculated as :

$$\text{MC}\% = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

The seeds were kept for germination at $25 \pm 1^\circ\text{C}$ in a dual chambered seed germinator with 8 hr of light. Germination test was made in petri-dishes. Germination tests in 4 replications of 100 seeds each were initiated within one day of collection as seed viability in this species is short. Germinant were counted when visible protrusion of the radicle was 1 mm long. Germination was monitored for 14 days with water being added as and when required.

Data were analyzed using two way ANOVA (Snedecor and Cochran, 1967) to determine differences in collection sources, fruit and seed characteristics, moisture content and germination.

Results and Discussion

Fruit Colour: The fruit colour was dark green during the first collection and pale yellow at final collection on both the sites (Table 1). ANOVA showed that fruit colour varied significantly across collection dates ($p < 0.01$). The interaction between site and collection date was also significant ($p < 0.05$).

Fruit and seed characteristics: From initial to final collection the change in fruit size was 23.99 mm^2 and in seed 0.96 mm^2 at Syat. In Duhani site the change in fruit size was 24.98 mm^2 and in seed was 1.11 mm^2 . (Table 1)

At Syat site the change in weight of 100 fruits was 10.34 g and at Duhani 8.33 g. The fruits of Syat were heavier than Duhani site and vice-versa for seeds. The change in the weight of 100 seeds was 10.74 g in Syat and 11.34 g at Duhani site (Table 1).

ANOVA showed that fruit size varied significantly across site and collection weeks ($p < 0.01$) whereas seed size varied significantly across sites ($p < 0.05$). The interaction between site and collection week was also significantly different for seed size ($p < 0.05$).

Weight of 100 fruits varied significantly across site ($p < 0.01$) and week ($p < 0.05$). Weight of 100 seeds was also significantly different across site and week ($p < 0.01$). Seed per 100 g also varied significantly across site and week ($p < 0.01$).

Germination: For all collection dates, seeds from both sites completed their germination in 8 to 14 days. The seeds collected on 20th May had 8% mean germination at Syat site and 12% germination at Duhani site, when seed moisture content was 74.5 and 77.73% respectively. The peak mean germination was 82.6 and 75.56% at Syat and Duhani sites when seed moisture content was 62.83 and 63.46% at both the sites respectively.

Table - 1: Effect of collection dates on fruit/seed characteristics of *A. butyracea*

Date	Fruit colour	Fruit size (mm ²)	Wt. of 100 fruit	Seed size (mm ²)	Wt. of 100 seeds	Seeds 100 gm ⁻¹
Syat						
20 May	Dark green	570.9 ± 2.22	949.6 ± 2.18	237.2 ± 0.12	124.7 ± 0.95	77.3 ± 1.57
24 May	Dark green	577.8 ± 3.16	953.0 ± 2.30	237.3 ± 0.11	128.4 ± 1.73	78.9 ± 0.75
28 May	Light green	580.9 ± 1.38	951.3 ± 5.78	237.5 ± 0.15	126.9 ± 2.37	77.7 ± 1.70
2 June	Light green	585.7 ± 1.54	948.0 ± 1.73	237.8 ± 0.14	117.7 ± 1.78	83.3 ± 3.11
6 June	Yellowish green	593.5 ± 1.68	946.7 ± 1.20	237.9 ± 0.05	122.9 ± 1.09	82.0 ± 2.64
10 June	Pale yellow	590.3 ± 1.46	948.3 ± 4.25	238.2 ± 0.05	118.3 ± 1.27	86.7 ± 1.45
14 June	Pale yellow	593.5 ± 1.74	950.3 ± 0.88	238.2 ± 0.14	118.0 ± 1.44	87.0 ± 1.52
18 June	Pale yellow	594.9 ± 1.46	939.3 ± 4.40	238.1 ± 0.09	118.2 ± 1.16	88.7 ± 1.20
Duhani						
20 May	Dark green	581.2 ± 4.41	823.3 ± 1.45	237.3 ± 0.11	114.7 ± 1.76	84.0 ± 2.30
24 May	Dark green	585.0 ± 1.80	821.7 ± 1.20	237.5 ± 0.15	116.7 ± 1.20	88.7 ± 2.96
28 May	Light green	590.3 ± 1.42	819.0 ± 0.57	237.8 ± 0.14	113.7 ± 3.17	88.3 ± 1.20
2 June	Light green	595.1 ± 1.90	821.0 ± 1.52	237.9 ± 0.05	111.7 ± 2.02	90.7 ± 0.33
6 June	Light green	601.3 ± 1.62	817.0 ± 1.52	238.2 ± 0.05	111.0 ± 1.15	91.7 ± 1.85
10 June	Yellowish green	603.0 ± 3.21	814.3 ± 0.88	238.2 ± 0.14	108.7 ± 0.88	92.7 ± 1.45
14 June	Yellowish green	607.9 ± 2.62	815.0 ± 1.73	238.1 ± 0.09	105.3 ± 1.20	92.3 ± 1.20
18 June	Pale yellow	606.1 ± 1.65	815.0 ± 3.05	286.4 ± 0.16	105.7 ± 1.20	92.0 ± 1.52
Site F Value	**	*	*	NS	*	*
CD at 5%	5.63	48.73	60.41	-	36.39	39.55
Date F Value	*	*	**	**	*	*
CD at 5%	0.49	4.25	5.27	11.39	3.18	3.45
Site × Date						
F Value	NS	NS	NS	**	NS	NS
CD at 5%	-	-	-	5.69	-	-

± = Standard Error, * = Significant at 1%, ** = Significant at 5%, NS = Non Significant

Table - 2: Effect of moisture content on seeds of *A. butyracea* across the collection dates

Date	Syat		Duhani	
	Seed Moisture (%)	Germination %	Seed Moisture (%)	Germination %
20 May	74.5 ± 0.45	8.0 ± 4.00	77.7 ± 1.64	12.0 ± 2.30
24 May	70.9 ± 0.80	12.0 ± 2.30	73.4 ± 1.47	12.0 ± 2.30
28 May	67.6 ± 1.13	26.7 ± 3.52	73.9 ± 0.47	21.3 ± 1.33
2 June	64.7 ± 0.70	42.7 ± 3.52	70.8 ± 0.36	40.3 ± 1.27
6 June	62.0 ± 0.93	58.7 ± 2.66	68.1 ± 1.04	46.3 ± 3.17
10 June	62.8 ± 1.33	82.7 ± 3.52	64.7 ± 1.10	65.6 ± 2.94
14 June	59.7 ± 0.53	80.7 ± 2.30	63.5 ± .89	75.7 ± 4.24
18 June	58.3 ± 1.19	72.7 ± 2.30	60.3 ± 1.10	75.6 ± 3.60
	Seed Moisture		Germination	
Site F value	*		NS	
CD at 5%	24.45		-	
Date F value	*		*	
CD at 5%	2.13		9.59	
Site × Date				
F value	NS		NS	
CD at 5%	-		-	

± = Standard Error, * = Significant at 1%, NS = Non Significant

Maximum seed germination was earlier at Syat compare to Duhani (Table 2).

ANOVA showed that moisture content of seed varied significantly across site and week ($p < 0.01$). Where as germination varied significantly only across weeks ($p < 0.01$).

Significant difference in germination of seeds collected from Syat and Duhani sites was observed on same collection dates. Brand *et al.* (1994) have also found such differences when comparisons were made between seeds for 10 separate populations in west Timor for *Santalum album*. However the germination for the seeds from these two sites was higher in comparison to the values reported by Tewari and Dhar (1997) and Beniwal and Singh (1989) for *A. butyracea*. Such differences may be due to variations in seed weight (Fox *et al.*, 1994) and seed moisture content (Pandit *et al.*, 2002). Moisture content in *A. butyracea* seeds decreased from 74.5 to 58.3% at Syat and 77.7 to 60.3% at Duhani. The maximum germination occurred when moisture content at both the sites was between 62.8 and 63.5% and declined with further decrease in moisture content. The variation of approximately 4-8 days in fruit/seed maturation at the two sites could be due to the initial difference in the moisture content of seeds and the temperature variation between the two sites because of the elevation. The mean difference being of 8°C at initial collection and 5°C at final collection. The change in fruit colour from dark green to pale yellow appears to be useful parameter for determining appropriate time of seed collection.

Seed moisture content and seed germination was negatively correlated. Maturity of seed of *A. butyracea* may be related to changes in fruit colour and moisture content of seed, which indicate

appropriate dates of collection to avoid large-scale losses in collecting non-viable seeds of this species, which has a short viability.

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