

## **Maturity Indices of Indian Horse-Chestnut (*Aesculus indica* Colebr) Seeds Under Temperate Kashmir Conditions**

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**Abstract.** The study on maturity indices of *Aesculus indica* seeds was conducted under temperate Kashmir conditions. Seed collection started from 15<sup>th</sup> July and continued till the maturation of seeds in the month of December. The seeds were harvested fortnightly from identified trees and on each collection date maturity parameters viz. seed colour, seed weight, moisture content, seed dimension, specific gravity, and germination percentage were recorded.

The study revealed that at the time of maturity (Nov-Dec) the seed colour is shiny chocolate brown, having a moisture content of 58.37 per cent and a specific gravity of 0.82. Germination percentage was maximum (80%) at its maturity with maximum seed weight of 52.03g/seed. Besides the seeds should be collected before their natural disposal.

**Key words:** *Aesculus indica*; maturity indices; seed weight; seed colour; specific gravity

### **Índices de Maturidade em Sementes de *Aesculus indica* Colebr, no Clima Temperado de Cachemira**

**Sumário.** O estudo sobre índices de maturidade em sementes de *Aesculus indica* efectuou-se no clima temperado de Cachemira. A colheita de semente começou a 15 de Julho e continuou até à maturação, no mês de Dezembro. Foi feita quinzenalmente, em árvores identificadas, e em cada data registaram-se parâmetros de maturidade da semente, tais como cor, peso, percentagem de humidade, dimensão, peso específico e percentagem de germinação.

O estudo revelou que na altura da maturação (Novembro-Dezembro) a cor da semente era castanho escuro brilhante, com 58,37% de humidade e peso específico de 0,82. A percentagem de germinação era máxima (80%) na maturidade, com peso máximo de 52,03g/semente. Além disso, as sementes devem ser colhidas antes que se verifique a sua queda natural.

**Palavras-chave:** *Aesculus indica*; índices de maturidade; peso da semente; cor da semente; peso específico

### **Indices de Maturité des Graines de *Aesculus indica* Colebr sous le Climat Tempéré de Cachemire**

**Résumé.** L'étude concernant l'indice des maturité de graines de *Aesculus indica* a été effectuée dans les conditions climatiques tempérées de Cachemire. La récolte des graines a commencée le

15 juillet et s'est prolongée jusqu'à la maturité, au mois de décembre. Tous les quinze jours on procéda à la récolte de graines sur des arbres marqués, et à chaque date des paramètres de maturité des graines furent enregistrés, tels que la couleur, poids, taille, poids spécifique et pourcentage de germination.

Ce travail a démontré que, en période de maturation (novembre-décembre) la couleur de la graine était marron brillant, ayant 58.37% d'humidité et 0.82 de poids spécifique. Le pourcentage de germination était maximum à la maturité, avec un poids maximum de 52.03g/graine. Les graines doivent être récoltées avant qu'elles ne tombent des arbres.

**Mots clés:** *Aesculus indica*; indices de maturité; poids de la graine; couleur de la graine; poids spécifique

## Introduction

Indian Horse-chestnut (*Aesculus indica* Colebr) locally known as '**Hanudun**' is found in temperate regions of Asia, Europe and America, partially East Asia, North Western Himalaya, North America with altitude varying from 900-3600m (SANTAPAU and HENERY, 1973).

The tree is medium to large sized, with canopy round to broadly spreading. Leaves are digitate/palmately compound with undulate margin and are opposite to sub-opposite in arrangement. Flowers are white to creamy white in colour. Fruit is a capsule and is light brown with green patches in colour. Seed is dark shiny brown in colour with dull white scar.

The tree is being widely used for afforestation purpose by forest Department in Kashmir valley. The tree is planted for ornamental purpose. Its leaves and seeds are used as fodder, wood as small timber, branches for making charcoal etc. In forests its seeds are eaten by monkeys, bears and other wild animals as fodder.

Seeds of *Aesculus indica* are big in size with high moisture contents and fall under the category of temperate recalcitrant seeds and remain viable for about one month only. Seeds being recalcitrant need to be collected well in

time so that they can be stored under proper conditions, as any delay in collection may result in the loss of viability. Therefore maturity indices studies are important because of the fact that the knowledge of exact stage and time of seed maturity is essential for collection of abundant quantity of healthy and vigorous seeds. Fully mature seeds collected at appropriate time retain viability longer than the seeds collected when immature (HARRINGTON, 1970 and STEIN *et al.*, 1974).

*Dipterocarpus retusus* (Hollong) seeds collected during first half of March were found to be most favourable for maximum germination (THAKUR *et al.*, 2000).

Change in colour of fruit provide a simple and in some species reliable criteria for judging seed maturity (WILLIAM, 1985). A relationship is often established between seed colour and maturity which is often used to identify physiological maturity of tree seeds as in *Plantanus occidentalis* (BONNER, 1972) and in *Quercus* spp. (BONNER, 1974).

SINGH and KACHARI, 2006 reported that the germination percentage of seeds increased with decrease in specific gravity and moisture content in cones of *Pinus kesiya* (Khasi pine).

Immature seeds die if they are allowed to dry out (HARRINGTON, 1972).

Thus, fruit collection should be started only when the seeds are sufficiently mature corresponding to the indicators of maturity for individual species.

### Materials and methods

The studies were carried out at post graduate level in the Faculty of Forestry, SKUAST-K, Shalimar, during the year 2006. The experimental site lies between 74.89° longitude and 34.08° latitude at an altitude of about 1587m amsl. The soil is silty loam type.

The climate in general is temperate; with severe winter extending from December to March. The region faces a wide temperature range from a minimum of -8.0°C in winter to a maximum of 33°C in the summers. Winter frost is common and medium to heavy snowfall is also witnessed. The area receives an annual precipitation of 676-1193 mm, with an average of 944.6 mm.

The optimal time for harvest is when a large quantity of viable germinable seeds can be collected. In order to determine the best time for collection of seeds, they were collected from pre-identified phenotypically superior trees. The seeds were picked from mid of July till their maturation at an interval 15 days and were subjected to germination test, specific gravity, moisture content, seed weight, change in fruit/seed coat color and seed dimensions.

The germination test was performed in petriplates lined with double fold germination paper at bottom. The seeds were placed sparsely in Petri plates and moistened. The plates were incubated at 25±1°C in B.O.D incubator for a period of 21 days. The plates were kept moist and inspected regularly. Seeds were considered to have germinated as soon

as radical emerged.

Various parameters were recorded and analysed as under:

i) The germination percentage was calculated as:

$$\text{Germination \%age} = \frac{\text{No. of seeds germinated}}{\text{Total No. of seeds}} \times 100$$

ii) Specific gravity of seeds was determined by water displacement method as described by (BARNET, 1979).

iii) Seed weight (g) was determined with the help of sensitive top pan balance. Eight replicates of hundreds each were used for determining seed weight.

iv) Moisture content was determined by using hot air oven on fresh weight basis as per (ISTA, 1993) recommendations.

v) Fruit/ seed coat colour was estimated on ocular basis.

vi) Seed dimensions were measured in terms of mid diameter (mm) and length (mm) with the help of digital calliper.

100 seeds in four replicates were used for taking observations.

### Results and discussion

Studies carried with respect to maturity indices showed that *Aesculus indica* Colebr comes into flowering in the month of May-June depending upon climatic, edaphic and topographic factors of the locality. The trees at lower altitudes start flowering earlier in late May while those at higher altitudes with cooler weather conditions start flowering by early June.

The data collected and presented in Table - 1 (Figure 1) showed that fruit colour, seed coat colour and specific

gravity had a relationship with the maturity of the seeds. The colour changes in Indian Horse-chestnut seed coat was observed from white, when immature to various shades of white with brown patches to shiny chocolate brown of the mature seed. (Plate 1-4). Germination in seeds started when seed coat colour was brown (24 percent) reaching to a maximum of 80 percent when seed coat colour was shiny chocolate brown. Change in colour of fruits provide a simple and in some species reliable criteria for judging seed maturity (WILLIAM, 1985). Colour change is directly related to the maturity of the seeds. In case of *Bauhinia restua* (semula), change in fruit colour from green to dark red and the seed colour from green to whitish brown is useful indicator of seed maturity (UPADHAYAY *et al.*, 2006). Seeds of *Aesculus hippocastanum* also undergo characteristic changes in the seed coat colour

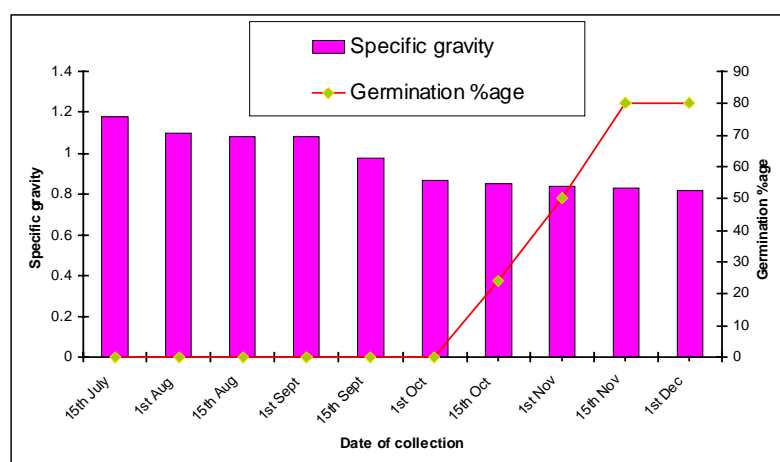
from white to brown as maximum seed fall approaches (THOMPSETT and PRITCHARD, 1993). Changes in colour of fruits of Junipers to deep blue have also been reported by STOECKLER and SLABAUGH, 1965.

The specific gravity of the seeds is another quick and reliable method of judging maturity of the seed. The specific gravity of the *Aesculus indica* seeds decreased from 1.18 (immature) to 0.82 with the maturity of the seed Table 1 (Figure 1) germination was recorded when the specific gravity of the seed was 1.18 (Max.) and fruit was light brown in colour and seed coat colour was white. However the maximum of 80 percent germination was recorded (Figure 1) when specific gravity was between 0.82 to 0.83 and colour of seed had turned to shiny chocolate brown. No germination was recorded at first six collection dates i.e from 15<sup>th</sup> July to 1<sup>st</sup> October (Table 1).

**Table 1** - Maturity indices of seeds of Indian Horse-chestnut (*Aesculus indica* Colebr) collected on different dates during 2006

Date of Collection		Colour		Specific Gravity	Seed Dimensions		Germination (%)
		Fruit	Seed Coat		Diameter (mm)	Length (cm)	
1 <sup>st</sup>	15 <sup>th</sup> July	Light brown	White	1.18	23.19	30.56	0
2 <sup>nd</sup>	1 <sup>st</sup> August	-do-	-do-	1.10	23.40	30.56	0
3 <sup>rd</sup>	15 <sup>th</sup> August	-do-	Creamy white	1.08	28.88	36.18	0
4 <sup>th</sup>	1 <sup>st</sup> September	-do-	-do-	1.08	36.81	43.00	0
5 <sup>th</sup>	15 <sup>th</sup> September	-do-	Creamy white with brown patches	0.98	42.20	45.55	0
6 <sup>th</sup>	1 <sup>st</sup> October	Light brown with green patches	-do-	0.87	45.13	48.64	0
7 <sup>th</sup>	15 <sup>th</sup> October	-do-	Brown	0.85	46.87	49...96	24
8 <sup>th</sup>	1 <sup>st</sup> November	-do-	Shiny chocolate brown	0.84	46.91	49.98	50
9 <sup>th</sup>	15 <sup>th</sup> November	-do-	-do-	0.83	46.98	49.98	80
10 <sup>th</sup>	1 <sup>st</sup> December	-do-	-do-	0.82	46.98	49.98	80

Dia (mm) – mid dia of seed; Length (mm) – length of seed



**Figure 1** - Effect of collection dates on specific gravity and germination percentage of *Aesculus indica* seeds



**Plate 1** - Fruit set of Indian Horse-chestnut tree stage



**Plate 2** - Indian Horse-chestnut fruits/seeds showing immature



**Plate 3** - Vertical section of immature chestnut Indian Horse-chestnut seed showing mucilaginous endosperm



**Plate 4** - Indian Horse- chestnut fruits/seeds at showing mature stage

Twenty four percent of seeds germinated on the 7<sup>th</sup> date of collection i.e on 15<sup>th</sup> October when specific gravity was 0.85 and increased to a constant of 80 per cent from 15<sup>th</sup> November to 1<sup>st</sup> December with specific gravity of 0.83 - 0.82. Germination percentage increases with decrease in seed/fruit specific gravity has been reported (SINGH, 1989). In *Celtis australis* (Hackberry) germination percentage increased from 0 - 23 per cent as the specific gravity decreased from 1.22 to 1.03 respectively (SINGH, 2006).

The studies were further conducted on relationship of seed weight and moisture percentage on maturation of seed. The data presented in Table 2 shows that seed weight in India Horse-chestnut seeds increased towards maturity. No germination recorded when the seed weight was between 7.50 to 32.22 g.

Germination percentage of 24 - 50 per cent was recorded when the seed weight was between 39.30 to 44.98 g. respectively. However, the maximum of 80 percent germination was observed when the seed weight was recorded as 52.03 g on last two collection dates i.e on 15<sup>th</sup> November and 1<sup>st</sup> December. Relative high seed weight is often desirable since it is correlated with rapid germination and good seedling establishment (GRIFFIN, 1972; SORESENSEN and CAMPBELL, 1993).

Studies further revealed that moisture content and germination percentage are negatively related (Table 2). The germination percentage increased with decrease in moisture percentage. No germination was observed when the

moisture content was recorded between 76.69 to 66.76 percent (15-07-2006 to 01-10-2006). However, maximum germination of 80 percent was recorded on 15<sup>th</sup> November when the moisture percent was lowest i.e 58.37 per cent. Decreased moisture content is a characteristic feature of maturation in *Dalbergia sisso*, moisture loss coincide with maturity (JOSHI, 2000). The maturity indices for harvesting pods in *Albizia lebbeck* (Kokko tree) is decrease in moisture content of seed and increase in its dry weight (BHARDWAJ *et al.*, 2002). SINGH (2006) reported the increase in germination percentage from 0 - 23 percent as the moisture content reduced from 52.19 to 31.63 percent in case of *Celtis australis* (Hack berry). Studies further showed that the seed dimensions i.e. mid diameter (mm) and length (mm) were low when seeds immature (Table 1) and showed increased trend as the seeds reached full maturity. When seeds were collected on 1<sup>st</sup> collection date (15<sup>th</sup> July), their length and mid-diameter were 30.56 and 23.19 mm respectively. As the seeds matured fully their dimensions were 49.98 mm long and 46.6 mm mid diameter.

Thus, the studies conducted on maturity indices of Indian Horse-chestnut seeds revealed that proper stage of harvesting seeds was when the seed coat colour changed from white to brown or shiny chocolate brown along with decline in moisture percentage and specific gravity of the seed. The maximum of 80 percent germination was therefore recorded on 9<sup>th</sup> and 10<sup>th</sup> collection i.e. from 15<sup>th</sup> November onwards.

**Table 2** - Relationship of seed weight and moisture content on germination percentage of Indian Horse-chestnut (*Aesculus indica* Colebr) seeds during 2006 at different stages of maturity

S. No.	Date of Collection		Seed weight (g)	Moisture (%)	Germination (%)
1.	1 <sup>st</sup>	15 <sup>th</sup> July	7.50	76.69	0
2.	2 <sup>nd</sup>	1 <sup>st</sup> August	8.72	74.42	0
3.	3 <sup>rd</sup>	15 <sup>th</sup> August	12.98	72.03	0
4.	4 <sup>th</sup>	1 <sup>st</sup> September	18.46	71.23	0
5.	5 <sup>th</sup>	15 <sup>th</sup> September	25.93	67.73	0
6.	6 <sup>th</sup>	1 <sup>st</sup> October	32.22	66.76	0
7.	7 <sup>th</sup>	15 <sup>th</sup> October	39.30	64.09	24
8.	8 <sup>th</sup>	1 <sup>st</sup> November	44.98	60.84	50
9.	9 <sup>th</sup>	15 <sup>th</sup> November	52.03	58.37	80
10.	10 <sup>th</sup>	1 <sup>st</sup> December	52.03	58.37	80

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