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## Physical parameters of adzuki bean [*Vigna angularis* (Willd.) Ohwi & Ohashi] genotypes

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### Abstract

The basic purpose of the study was to assess the physical parameters of the three genotypes of adzuki bean viz. EC-340264, HPU-51, and Local *Totru*. The length of the seeds varied from 6.00 to 8.10 mm. Whereas, the width of the seeds varied from the 4.40 to 6.00 mm. Similarly, the 1000 kernel weight of the adzuki bean seeds varied from the 50.01 to 115.07 g/1000 seeds. True density of the seeds varied from the 1.01 to 1.62 g/ml. The study of the physical parameters can be helpful for the engineers and food processors in developing new structures for storage and processing.

**Keywords:** adzuki bean, physical parameters

### Introduction

Adzuki bean [*Vigna angularis* (Willd.) Ohwi and Ohashi], syn. [*Phaseolus angularis* (Willd.)], belongs to Leguminosae family, its pods are cylindrical in shape with a length of 6-12 cm, containing 4-12 seeds and the colour of the straw is blackish and brown and constricted between seeds. Adzuki bean is a self-pollinated crop and the shape of the seeds varies from cylindrical to cordate with a seed coat ranging from smooth, wine red, occasionally buff, black or mottled seed. In East Asia it is grown as a traditional pulse crop, where it is used as a source of protein for human nutrition especially in developing and underdeveloped countries. The regions where it grows profoundly are mostly temperate and sub temperate regions. (Rubatzky and Yamaguchi, 1997) [9].

In context of India, the cultivation of the adzuki bean is limited to the North-eastern and Northern hill zones. It occasionally grows in Kangra, Chamba, Mandi and Sirmour districts of Himachal Pradesh (Shweta, 2013) [10]. Adzuki bean is a very tolerant crop which can sustain heavy rainfall and can grow in all types of soil.

Adzuki bean is also popular with the name of red beans, they are used in many confectionery items in the orient as a popular ingredient. The predominant use of adzuki bean in traditional Japanese confections is a paste or *wagashi* such as *youkan*, *manju* and *amanatto*. Adzuki bean is a rich source of carbohydrates, protein, vitamins, minerals and fiber (Tjahjadi *et al.*, 1988) [11], however they also contain anti nutritional factors. Phytates,  $\alpha$ -galactosides and trypsin inhibitors are among these factors, and their concentrations differ widely among the different cultivars of adzuki beans.

Physical properties can be defined as the characteristics of materials (agricultural products) that can be quantified, or the state of the material (Glinski *et al.*, 2011) [4]. Data on physical properties is required for designing the machines and storage structures. This information is important to engineers, food scientists, processors, and others who may exploit these properties to find new uses. The size and shape are, for instance, important in their separation from undesirable materials and in the development of sizing and grading machinery (Mohsenin, 1970) [6]. Surface area and volume of pulse seeds are important physical characteristic in harvesting, cleaning, separation, handling, aeration, drying, storing, milling, cooking and germination (Hsieh *et al.*, 1999) [5].

In the present study the efforts are made to assess the physical properties of the adzuki bean genotypes viz. EC-340264, HPU-51, and Local *Totru*

### Materials and Methods

#### Procurement of raw material and sample preparation

Different genotypes of adzuki bean were procured from the Department of Organic Agriculture, College of Agriculture, CSK Himachal Pradesh Agricultural University,

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Palampur. Chemicals and other ingredients required for analysis and product development were procured from the reputed local suppliers.

Initially procured adzuki beans samples were cleaned to remove damaged seeds, dust and other foreign materials. For analyzing different physical parameters.

### Physical parameters

**Colour and shape:** The colour and shape of seeds were noted visually.

**Size:** Size of the seeds in terms of length and width were measured in mm by using vernier caliper.

**Thousand kernel weight:** For measuring the 1000 kernel weight, about 250 clean and full seeds of adzuki beans were taken and weighed.

Calculations: Weight of 250 grains = a g

Weight of 1000 grains = a g × 4

**True Density** True density is the weight per unit volume of individual seed. True density of seeds was determined using the liquid displacement method of Mohsenin, 1980<sup>[7]</sup>. Toluene (C<sub>7</sub>H<sub>8</sub>) was used as it is absorbed by seeds to a lesser extent than water. Besides, it has low surface tension so that it fills even shallow dips in a seed and its dissolution is low.

$$\text{Density (g/ml)} = \frac{W \text{ (g)}}{V \text{ (ml)}}$$

Where,

W = weight of 1000 seeds and V = rise in toluene level after adding seeds.

**Bulk Density:** Bulk density of seeds was assessed by using the method of Narain *et al.*, 1978<sup>[8]</sup>. A calibrated graduated cylinder (1000 ml) was filled with seeds upto the mark. The contents of the cylinder were weighed. The bulk density of individual sample was calculated by dividing the weight by 1000 and expressed as g/ml.

**Porosity:** The porosity of the seed was assessed by using the method of Mohsenin, 1970<sup>[6]</sup>. The porosity ( $\epsilon$ ) of the bulk is the ratio of spaces in the bulk to its bulk volume and was determined by the following equation

$$\epsilon = 100 [1 - \text{Pb}/\text{Pk}]$$

Where  $\epsilon$  is the porosity in percentage; Pb is bulk density in g/ml and Pk is seed density in g/ml.

### Result and Discussions

**Colour:** Data in Table 1 pertains to the physical parameters of different genotypes of adzuki bean. The colour of the seeds of

the selected genotypes of adzuki beans varied from bright red to dark maroon to yellowish green Table 1. As is evident from the table the colour of EC-340264 genotype was bright red and that of HPU-51 and Local Totru was dark maroon and yellowish green respectively. Bhagmal (1994)<sup>[3]</sup>. Described the adzuki bean seed coat as smooth, with wine red colour, occasionally buff, black or mottled.

**Shape:** Shape of the EC-340264 seeds was round with protruding edge on the side, thick round with protruding edge in the HPU-51 and thin round with protruding edge on the side in local Totru (Table 1). The shape of the seeds of adzuki bean was described as cylindrical to cordate (Bhagmal, 1994)<sup>[3]</sup>.

**Size:** Size is an important physical attribute of seeds used in screening solids to separate foreign materials, and also in heat or mass transfer calculations. Length, width, thickness and equivalent diameter are commonly used measures of size (Ahmed, 2013)<sup>[1]</sup>. Length in the adzuki bean seeds varied from 6.00 – 8.10 mm. The maximum length of the seeds was observed in the EC - 340264 (8.10 mm), followed by HPU-51 (7.20 mm) and Local Totru (6.00 mm). The width of the seeds varied from 4.40 – 6.00 mm, with maximum width in HPU- 51 (6.00 mm), followed by the EC- 340264 (5.10 mm) and the local Totru (4.40 mm). There was a non-significant ( $P \leq 0.05$ ) variation in all the genotypes (Table - 4.1).

Thousand kernel weight Thousand kernel weight of the seeds ranged from the 50.01 – 115.7 g/1000 (Table 1). The statistical evaluation showed a significant difference in all the genotypes with highest value in the HPU-51 (115.07g/1000), followed by EC-340264 (77.41g/1000) and Local Totru (50.01g/1000). Almost similar results have been reported by Ai *et al.* (2015)<sup>[2]</sup>. Where the mean weight of 100 adzuki bean seeds was 5.84±2.05 g.

**True density and Bulk density** The true density is the density of the solid material excluding the volume of any open and closed pores whereas, bulk density is the density of a material when packed or stacked in bulk. The bulk density of a material depends on the solid density and the geometry, size and surface properties of the individual particles. The mean values for the true and bulk density of different genotypes of adzuki bean varied between 1.01 to 1.62 g/ml and 0.25 to 0.75 g/ml respectively (Table 1). A Significant ( $P \leq 0.05$ ) differences in bulk and true density of adzuki beans was observed among different genotypes.

**Porosity** Porosity is defined as the volume fraction of the air or the void fraction in the sample. The values for porosity varied from 10.56 – 78.02 per cent among the adzuki bean genotypes (Table 1). A significant difference was observed in the porosity percentage at 5 per cent level of significance. Among different genotypes, Local Totru showed minimum values for porosity (10.56%) followed by EC-340264 (54.15%) and HPU-51 (76.02%).

**Table 1:** Physical parameters of different genotypes of adzuki bean

S. No.	Parameters	Genotypes			
		EC-340264	HPU-51	Local Totru	CD ( $P \leq 0.05$ )
1.	Colour	Bright red	Dark maroon	Yellowish green	-
2.	Shape	Round, with protruding edge on the side	Thick Round, with protruding edge on the side	Thin Round with protruding edge on the side	-
3.	Length (mm)	8.10	7.20	6.00	NS
4.	Width (mm)	5.10	6.00	4.40	NS
5.	1000 kernel Weight (g/1000)	77.41	115.07	50.01	1.74
6.	True density (g/ml)	1.62	1.11	1.01	0.15

7.	Bulk density (g/ml)	0.75	0.25	0.90	0.12
8.	Porosity (%)	54.15	78.02	10.56	0.13

### Conclusion

The HPU-51 genotype of adzuki bean had the highest 1000 kernel weight, lesser bulk density and more porosity in comparison to other genotypes of the adzuki bean which could be due to the shape i.e. thicker and rounder than other two genotypes of adzuki bean.

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