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## Botanical description of garden cress (*Lepidium sativum* L.) plant and physical characteristics of its seeds

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**Abstract**

The aim of this study was to determine the botanical description of garden cress (*Lepidium sativum* L.) plant and the physical characteristics of its seeds. Garden cress (*Lepidium sativum*) is an annual, fast growing edible herbaceous plant that belongs to Brassicaceae family and therefore has properties very much similar to mustard and watercress as information of physical properties of plant and its seeds is very useful in designing equipments for harvesting, storage of grains, sorting, sizing, processing and other post-harvest operations so, Botanical description of garden cress plant was studied this fast-growing plant grow up to a height of 50 cm had small sized, white to pinkish flowers and crop can grow easily using less equipment's facilities. The Physical properties i.e. colour, shape, taste, dimension (length, width, and thickness), bulk density, true density, porosity, sphericity, angle of repose and 1000 grain weight were measured. The seeds were very small in size and shape as evident from their dimensions as length, width and thickness were recorded as 2.60 mm, 1.20 mm and 0.94 mm respectively. Bulk density, true density and porosity were observed as 729.74 kg/m<sup>3</sup>, 1230 kg/m<sup>3</sup> and 40.67 percent respectively.

**Keywords:** Garden cress, plant, botanical description, grow, physical characteristics

**Introduction**

Garden cress (*Lepidium sativum* L.) is a fast-growing, perennial edible plant that is commonly related to mustard and watercress. Garden cress belongs to Family: Brassicaceae, Genus: Lepidium. Species: Sativum, Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida and Order: Brassicales (Table 1). It is cool season herb that is native to South West Asia and Egypt but is widely cultivated in hot temperate climates throughout the world for various culinary and medicinal uses (Shabbir *et al.* 2018) [16]. This plant is commonly referred by different names in all over the world as illustrated in Table 2. In India, this plant has been considered as an important nutritional and medicinal plant since the Vedic era due to its health promoting properties and is referred by different names in Sanskrit language and is also known by variety of vernacular names in India as shown in Table 3.

Garden cress can be grown at all elevations, throughout the year, but the best crop is obtained in the winter season (Wealth of India, 1962) [19]. Cress is a spring crop but can be cultivated throughout the year but the optimal month of sowing garden cress crop are cool months of November, January and February in Mediterranean climate (Tuncay *et al.* 2011) [21] with yields reaching as high as six tons per hectare (Gupta, 2006) [11, 17]. It can be grown in any type of climate and soil condition and about 150 species are found in the temperate and sub temperate areas in the world. Although it is well suited to all type of soils, high fertile soil is required to produce high quality with rapid growth. It grows spontaneously in areas nearby the crops (Jain and Grover, 2016) [13].

Garden cress is grown in all parts of India and often used, most typically as a garnish or as a leaf vegetable due to its peppery, tangy flavour and aroma in the Indian cuisine (Divanji *et al.* 2012) [6]. In India, it is mainly cultivated in States of Gujarat, Uttar Pradesh, Madhya Pradesh, Rajasthan and Maharashtra (Shanthipriya *et al.* 2018) [18]. Seeds, leaves and roots of garden cress are of economic importance, however, the crop is mainly cultivated for seeds (Tiware and Kulmi, 2004) [20]. However, it is also utilized as leafy vegetable. No statistics has been exhibited to show the annual production because it is cultivated on small scale for local market and medicinal use.

Garden cress seeds are small in size, smooth in texture, oval in shape and reddish brown in colour (Verma and Rana 2020) [23]. Seed coat covers 12–17 % and the innermost structure; embryo is surrounded by the endosperm. Its bran has high water holding capacity and high dietary fibre (74.3%). (Diwakar *et al.* 2010) [7].

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Garden cress seeds are categorised under oilseeds and are enriched with macro and micronutrients. The seeds are high in calories (454 kcal) having 25 gm protein, 24 gm fat, 3 gm dietary fibre and 33gm of carbohydrates per 100gm and also has significant amount of minerals viz., 377 mg of calcium, 430 mg magnesium and 723 mg of phosphorous and sufficient amount of vitamins, mainly niacin (14.3 mg), riboflavin (0.61 mg) and thiamine (0.59 mg) and per 100g seeds (Gopalan *et al.* 2010; Chaudhary and Gupta, 2017) <sup>[11, 17]</sup>. It is the highest iron containing plant source ever known, about 100 mg/100g of iron is present in garden cress seeds having a better bioavailability (Chand *et al.* 2010). The seeds also act as memory boosters as it contains good amount of essential fatty acids like linolenic (26–34 %), linoleic (7.5–11.8 %) and arachidic (2–3.5 %) acid. (Jain and Grover 2016) <sup>[13]</sup>

Garden cress seeds have been used in traditional foods and medicine supplements since ancient times in India (Mali *et al.* 2007). Garden cress is rich in many phytochemicals, which are responsible for its therapeutic nature and a wide range of positive physiological effects on human health. The seeds are considered to have medicinal values such as galactagogue, anticarcinogenic, antidiabetic, antiasthmatic and antiarrheal. This highly nutritious plant can easily be cultivated using less equipment's facilities, less irrigation in any type of soil and climatic condition (Falana *et al.* 2014). Despite of its easily growing conditions, still this crop it is rarely cultivated because of lack of awareness regarding the crop and its nutritional and health benefits. It has not received due attention and has remained an under-utilized crop altogether, cultivated and utilized to a lesser extent in Himachal Pradesh. With this backdrop, a study was therefore undertaken to study the botanical description of garden cress plant and to assess the physical characteristics of garden cress seeds.

## Methods and Materials

### 1. Botanical description of garden cress plant

To study the botanical description of garden cress plant, garden cress seeds were sown in an experimental field. The field was monitored at periodic intervals to check the growth of plants and to study the botanical characteristics.

### 2. Physical characteristics of the garden cress seeds

The garden cress seeds were cleaned manually for removing adhering dirt, dust and foreign particles along with shrunken and broken seeds. Healthy and sound garden cress seeds were selected for studying the physical properties by using standard procedures. The colour of the seeds was observed subjectively through visual appearance. The shape of the seeds was observed from its physical/visual appearance. The taste of the seeds was analyzed organoleptically. A total of 10 garden cress seeds were selected at random. Their length, width and thickness were measured by using vernier calliper, averaged and reported in mm.

The Bulk density of garden cress seeds was determined by using the method used by (Guru *et al.* 2014) <sup>[12]</sup> by filling healthy garden cress seeds in 100 ml graduated cylinder up to a certain level followed by a slight tapping of cylinder and further weighing of the filled seeds then bulk density was calculated by dividing the weight of the seeds by the volume of the measuring cylinder taken.

$$\text{Bulk density (kg/m}^3\text{)} = \frac{\text{Weight}}{\text{Volume}}$$

True density of garden cress seeds was measured by the toluene displacement method in which graduated cylinder of 100 ml volume was filled with toluene up to the desired volume. Weighed quantity of healthy seeds was poured into it from a height of approximately 15 cm. The volume displaced by the seeds within a few seconds was noted. True density was calculated by dividing the weight of the seeds by the rise in the level of the volume of toluene after the addition of the seeds.

$$\text{True density (kg/m}^3\text{)} = \frac{\text{Weight}}{\text{Volume}}$$

Porosity of garden cress was measured by putting the value of bulk density and true density in the below-mentioned formula.

$$\text{Porosity} = (\text{true density} - \text{bulk density}) / \text{true density} \times 100$$

Sphericity of garden cress seeds was determined by using the method used by (Chhabra and Kaur, 2017) by putting the value of length, width and thickness in the below mentioned formula.

$$\text{Sphericity} = \frac{(\text{length} \times \text{width} \times \text{thickness})^{1/3}}{\text{Length}} \times 100$$

Angle of repose was measured by using the method used by (Firouzi and Alizadeh, 2012) <sup>[9]</sup> by dropping garden cress seeds on a plain surface at a height of about 30 cm, which resulted in a conical pile. Then, with the help of measuring scale, the length of the base of the pile and height of pile was measured. By putting values of length of base and height in the below-mentioned formula, angle of repose of seeds was calculated.

$$\Theta = \tan^{-1} (2 \text{ height} / \text{base})$$

To calculate the 1000 grain weight thousand healthy garden cress seeds having almost same size and shape were sorted out and weighed on an electronic weighing balance in triplicate and the average weight of seeds was expressed in grams.

## Results and Discussion

The experimental findings obtained from the present study have been discussed in following heads:

### Botanical description of garden cress plant

Garden cress (*Lepidium sativum*) is an annual, fast growing edible herbaceous plant that belongs to Brassicaceae family and therefore has properties very much similar to mustard and watercress. Study was initiated with a baseline survey which was conducted in selected areas of District Kangra where progressive farmers of the area were approached and were asked about the cultivation of garden cress crop. Some farmers were of the view that though this underutilized crop was occasionally sown by their ancestors on small scale but, now days it is rarely cultivated because of lack of awareness regarding the crop and its nutritional and health benefits and therefore, lack of demand by the consumer. In some areas of the district, garden cress seeds are sometimes mixed with fodder crop and fed as mixture in animal feed. Therefore, to study the botanical description of garden cress plant, garden cress seeds were sown in a small field in winter season, in the month of November.

The soil was dug and mixed well with manure before cultivation of seeds. The seed were sown thickly 5-6 cm deep in wide rows, 35-40 cm apart to have a continuous crop. Soil was kept moist and seeds were covered until germination. It was grown in semi shaded field this crop can also grow well even without any shade. Growth of garden cress was rapid. In a few days after sowing, the plants are ready for cutting. The plants that grew were erect, glabrous and grew up to an average height of 50cm. Plant had leaves were lobed shape with linear segments. Long shaped leaves were present at the bottom of the stem and small green feather-like leaves arranged on opposite side of its stalk at the top Figure1. Though they differed a bit in shape yet the taste was the same. The plants bore flowers after two months of sowing. Flowers were small in size, white to pinkish in colour and formed a highly clustered inflorescence have many branches on the upper part Figure2. The seeds were encased in small obovate pods of about 5 mm length. The crop was ready within a period of 90 days and seeds were collected in the month of February. Due to its short growing period, cress has a low fertilizer requirement. Field of garden cress plant is shown in Figure3. The results of present investigation corroborated well with the study done by (Verma and Rana 2020 and Prajapati and Dave 2018) [23]. Seeds, leaves and roots of garden cress plant are economically important, however, the crop is mainly cultivated for seeds. The botanical characteristics of garden cress plant are presented in (Table 4).

#### Physical properties of Garden cress seeds

Optimization of design parameters of agro-processing equipment used in production, handling and storage processes of seeds and grains requires an understanding of their physical and engineering characteristics. Physical characteristics of the material such as shape, size, volume, density, surface area and coefficient of friction are important and essential engineering data in design of machine, structures, and controls; in analyzing and determining the efficiency of a machine or an operation; and in evaluating and retaining the quality of the final product. Generally, the physical properties of grains are essential for the design of equipment for handling, harvesting, aeration, drying, storing, dehulling and processing. These properties are affected by numerous factors such as size, form, superficial characteristics and moisture content of the seed. So, it is important to have an accurate estimation of shape, size, volume, density and other properties that not only describes the quality but also aids in process methodology and designing of machinery in the food chain from farm to table. Garden cress is herb that plays an important role in human diet and among easily available plant sources containing good amount protein, calcium, iron and phosphorus. However, despite its important roles, there is a lack of information on the physical properties of garden cress. The second objective of this study focused on determination of physical properties. Healthy and sound garden cress seeds were selected for studying the physical properties viz. colour, shape, taste, dimension (length, width, and thickness), bulk density, true density, porosity, sphericity, angle of repose and 1000 grain weight and the results compiled for these parameters are presented in Table.5.

Some physical attributes greatly influence consumer's perceptions of food. Colour is an important primary factor for

characterization, grading, processing and trade of foods and their products. The garden cress seeds were reddish-brown in colour having an oval shape and a peppery, pungent taste with hot mouth feel. The geometric properties such as size and shape are one of most important physical properties considered during the separation and cleaning of agricultural grains. Dimensional properties viz. length, width and thickness were measured using vernier calliper and were calculated as 2.6mm, 1.2mm, 0.94mm, respectively. These dimensions clearly indicate smaller size of cress seeds. Sphericity expresses the characteristic shape of a solid object relative to that of a sphere of the same volume. Sphericity was measured by putting the values of the above dimensions in a formula that was calculated as 54.59 %. Thousand healthy garden cress seeds having almost the same size and shape were sorted out and weighed on an electronic weighing balance. The average weight of garden cress seeds was expressed as 1.86g.

Measurement of density is important in packaging and transportation of food and grading and separation processes and is greatly influenced by the size and shape of the food and food products. True density and bulk density of garden cress seeds were measured using a graduated cylinder and were calculated as 1230 Kg/m<sup>3</sup> and 729.74 Kg/m<sup>3</sup> respectively.

Porosity indicates the volume fraction of void space or air space inside a material. Higher the porosity, better the aeration and water vapour diffusion during deep-bed drying it is an important data necessary to design the aeration systems during storage there for required for sizing hoppers and storage facilities. Porosity of garden cress seeds was measured by putting the values of bulk density and true density in a formula which was expressed as 40.67 %.

The angle of repose is an important parameter for the design of processing, storage, and conveying systems of particulate materials. The dynamic angle of repose was the measured angle between the horizontal and the natural slope of the seeds heap. The height of the heap was measured and the dynamic angle of repose for garden cress seeds was calculated as 20.59°. The results of present investigation corroborated well with the study done by Behrouzian *et al.* (2013) [1] who calculated length, width and thickness of garden cress seeds as 2.6, 1.2 and 0.94 mm, respectively. They estimated 1.96 g weight of 1000 seeds. Physico-chemical properties of garden cress seeds determined by Deshmukh *et al.* (2017) [5] revealed true and bulk densities of garden cress seeds as 0.76 and 1.25 g/ ml with porosity of 39.2% and angle of repose as 19° respectively.

**Table 1:** Taxonomic classification (USDA, 2019)

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Capparales
Family	Brassicaceae
Genus	<i>Lepidium</i>
Species	<i>Lepidium sativum</i>



**Table 2:** Foreign names of garden cress plant (Sahil *et al.* 2016)

English	Cress, Common Cress, Garden cress, pepper cress	Spanish	Lepido, Mastuerzo, berrohortense, lepidio, berro de jardín
German	Gartenkresse	Italian	Agretto, Cressione
French	Cresson de fontaine, Cressanalois, Passeragecutivee	Arabian	Habburshad
Russian	Kress-Salat	Portuguese	Masturco, Mastruco, Agrião-Mouro, Herba Do Esforzo.

**Table 3:** Vernacular names of garden cress plant in India (Prajapati and Dave, 2018)

Hindi	Chandrasur, Halam, Chansur, Halim	Sanskrit	Raktabija, Chandrika, Charmahantri, Pashu, Mehana, Karika, Nandini, Karavi, Bhadra, Suvasara, Vasapushpa, Chand Shura
Himachali	Haloyen	Urdu	Halim
Kashmiri	Alian	Punjabi	Halium, Holan, Shargundai, Tezak
Marathi	Haliv, Ahaliva,	Gujarati	Asheliyo, Asaliya
Assamese	Candriki, Halim Shak	Bengali	Halim Shak, Alevarie
Malayalam	Asali	Oriya	Hidamba saga
Telugu	Adiyalu, Adeli	Tamil	Alivirai, Ativerai
Manipuri	Chantruk	Kannada	Allibija, , Kurthika

**Table 4:** Botanical description of garden cress plant

Characteristics	
Height	47-50cm
Leaves	Lobed shape with linear segments
Flowers	Small, white to pinkish in colour
Pods	Obovate, 5 mm length
Harvesting time after sowing seeds	90 days

**Table 5:** Physical characteristics of garden cress seeds

Parameters	
Colour	Reddish-brown
Shape	Oval
Taste	Peppery, pungent taste with hot mouth feel
Dimensions	
Length (mm)	2.60
Width (mm)	1.20
Thickness (mm)	0.94
Sphericity (%)	54.59
Bulk density (kg/m <sup>3</sup> )	729.74
True Density (kg/ m <sup>3</sup> )	1230
Porosity (%)	40.67
Angle of repose (°)	20.59
Weight of 1000 seeds (g)	1.86

**Fig 3:** Field of garden cress

## Conclusion

*Lepidium sativum* is an easily grown crop with few requirements that is ready within a period of 90 days. The plants were erect, glabrous and grew up to an average height of 50cm. Leaves were lobed shape with linear segments. Flowers were small in size, white to pinkish in colour and formed a highly clustered inflorescence. The seeds were encased in small obovate pods of 5 mm length and can grow in any kind of soil condition without having special technical knowledge. The seeds were reddish-brown in colour having an oval shape and a peppery, pungent taste with hot mouth feel. The seeds were very small in size and shape as evident from their dimensions (L-2.60, W-1.20, T-0.94mm) and thousand seed weight (1.86g). The seeds had porosity of 40.67% and true density 1230 kg/ m<sup>3</sup>.

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**Fig 1:** Lobed shaped piquant leaves of garden cress**Fig 2:** Raceme inflorescence of garden cress plant

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