ISPEC Tarım Bilimleri Dergisi
5(2): 456-462, 2021
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Araştırma Makalesi

E-ISSN:2717-7238
www.ispecjournal.com

ISPEC Journal of Agr. Sciences
5(2): 456-462, 2021
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Research Article

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DOI
https://doi.org/10.46291/ISPECJASvol5iss2pp456-462

Alınış (Received): 27/02/2021
Kabul Tarihi (Accepted): 29/03/2021

Keywords
Jute, *Corchorus capsularis*, *Corchorus olitorius*, seed dimension, seed characteristics

A Study on the Determination of Some Physical and Physiological Properties of Seeds of Two Different Jute Varieties (*Corchorus capsularis* L. and *Corchorus olitorius* L.)

Abstract
In recent years, the production of natural and recyclable, environmentally friendly products has come to the fore rather than textile and textile products produced from petroleum resources. One of the materials used in the production of these products is the Jute plant. This study was carried out in a laboratory environment under controlled conditions between 2019 and 2020. In the study, some physical (shape-size, surface area, average arithmetic-geometric diameter, sphericity, thousand grain weight) and physiological properties (germination percentage and time, average shoot-root lengths) of seeds belonging to two different varieties of Jute plant (*Corchorus capsularis* L. and *Corchorus olitorius* L.) were determined. According to the data obtained; It has been determined that *C. capsularis* variety has a short and oval structure, while *C. olitorius* variety has a medium and oval structure. Furthermore, the germination rate was determined as 74.5% in *C. capsularis* seeds and 63.5% in *C. olitorius* seeds.

INTRODUCTION

Nowadays, interest in composite products made of natural or recyclable materials rather than synthetic products is increasing day by day. Accordingly, the usage area of these natural materials, which are healthy, long-lasting and highly resistant, also diversifies and increases at the same rate. Jute plant is one of the preferred materials in the production of these products. Jute has gained an important place among the materials used in the production of products that are completely soluble in nature and suitable for reuse (Zhong et al., 2021).

Jute belongs to the genus *Corchorus* of the Tiliaceae family, an annual dicotyledonous plant with a woody structure (Çalışkan, 2013; Bilgili et al., 2018). Although about 40 wild species are known, *Corchorus capsularis* (white-Deshi jute) *and Corchorus olitorius* (black-Tossa or Boghi jute) varieties are generally grown. It is reported that the *Corchorus capsularis* is from Burma and the origin of *Corchorus olitorius* is from Africa (İslam and Alauddin, 2012). Jute plant, which is a heat-loving plant, is generally grown in tropical and subtropical climates. Therefore, the most important jute producers are countries such as China, India, Philippines, Japan, Caribbean, Malaysia, Egypt, Sudan, Thailand and Bangladesh. Approximately 95% of the jute production in the world is provided from these countries (Samra et al., 2007; Data et al., 2016). In Turkey, Antalya, Adana, Hatay and Southeastern Anatolia Region is specified may be made of jute cultivation (Cagirgan et al., 2014; Bilgili et al., 2018; Kitis and Kaya, 2018).

Jute plant needs it to grow at a temperature of about 22-35 °C. The annual precipitation requirement of the plant is approximately 418 mm and it needs a growing period of 120-150 days. This situation may vary according to the climatic characteristics and the annual average precipitation (Bilgili et al., 2018). In general, it prefers alluvial and sandy soils with a pH between 5.5 and 8.5. It consists of thin, long edges with serrated leaves on the straight-upright stem, which can be lengthened up to about 2-5 m if it does not encounter water shortage, generally not very branched (Çalışkan, 2013). The flowers of the jute plant, which is produced as a summer (cultivated from May to June), are yellow with a hermaphrodite structure (Kitis and Kaya, 218). Depending on the characteristics of the land and soil, it can be planted with 20-30 cm row spacing and 5-7 cm intra-row spacing (considering planting with spreader sowing and sowing machine). It is recommended to use 4-6 kg per hectare from *C. olitorius* variety and 6-8 kg per hectare for *C. capsularis* in crop production aimed at fiber production. It can benefit from tools and machines used for sugar cane for harvesting (Bilgili et al, 2018).

Jute is a product preferred not only by its fiber properties but also by the food and pharmaceutical industries. In Cyprus, it is made from the leaves of this plant in a dish called Molehiya. In addition, this plant is used in feeding animals (Çalışkan, 2013). It is also used in many areas, from jute to paper, textile products, carpets, curtains and mats, as well as renewable films, packaging materials, electrically conductive films or information storage devices (Bilgili et al., 2018; Zhong et al., 2021). The fact that this plant, which the spice industry is also interested in due to its being an aromatic plant, is completely recycled to nature, is an environmentally friendly material, allowing it to be used in composite materials, especially in the production of materials that are essential for recycling in different sectors. Jute plant consists of approximately 59-63% cellulose, 21-24% hemicellulose, 12-14% lignin, 0.4-0.8% wax, 0.2-0.5% protein, and 0.6-1.2% mineral (Data et al., 2016). It also has an antioxidant effect depending on the content of vitamins A, C, B and E, essential amino acids, minerals such as iron and calcium, and alpha tocopherol and phenol content (Idris et al., 2009; Öztürk and Savaroğlu, 2011; Adeyemo et al., 2021). Used in traditional medicine as well as in modern medicine,

jute is used in the treatment of diseases such as diabetes, dysentery, typhoid, especially in Nigeria (Adeyemo et al., 2021).

In addition, researches are carried out to evaluate the jute plant as an alternative solution to the roughage need experienced in animal nutrition. Çalışkan (2013) determined that the yield of jute per hectare is approximately 1823 kg, the dry matter ratio and metabolic energy value are 23.59% and 2062.88 kcal kg^{-1} and have the characteristics of high quality roughages. For this reason, it is anticipated that rations consisting of jute plant or including this plant can be used in feeding animals, especially when the need for roughage is not sufficient.

In recent years, the production of natural and recyclable environmentally friendly products, rather than textile and textile products produced from materials obtained from petroleum resources, has come to the fore. In this sense, jute is a plant suitable for this need with its many properties (such as strength, conductivity, ventilation) (Wang et al., 2020). The average fiber length of the jute plant is about 16-24 cm and the fiber fineness is between 125 microns. Although the color of the fibers becomes darker with time, it can generally vary from bright light yellow to brown. Although this color change that sometimes occurs is negatively viewed, it is tried to create a balance by changing the place and amount of jute. Jute can hold approximately 34% moisture in humid environments. Although the flexibility of its fibers is not very high, it is good in terms of tensile strength (Mutlu, 2012). Therefore, it is widely used in ropes, packaging materials and industrial textile products that need strength (Zhong et al., 2021).

In this study, seeds of two different jute varieties (*Corchorus capsularis* L. and *Corchorus olitorius* L.) were examined. Although there are many studies on the strength of the plant and its use in textile products, unfortunately, there is no study on seed properties. For this reason, some physical and physiological properties of seeds belonging to two different jute varieties determined in the study were determined.

MATERIAL and METHODS

This study was conducted in the laboratories of Bingol University Faculty of Agriculture Biosystem Engineering and Ege University Faculty of Agriculture Agricultural Machinery and Technologies Engineering Departments in 2019-2020. Seeds were obtained from Bingol University Faculty of Agriculture. Some physical (shape-size, surface area, average arithmetic-geometric diameter, sphericity, thousand grain weight) and physiological (germination percentage and time and average shoot-root lengths) belonging to two different jute varieties of seeds (*Corchorus capsularis* and *Corchorus olitorius*) properties have been determined. The characteristics of the seeds were determined in triplicate and the data obtained were evaluated according to the basic statistical parameters (minimum, average, maximum and standard deviation).

Some physical properties of jute seeds

There are characteristic features of each seed. These consist of properties such as the structure, shape and weight of the seeds. These basic features are important in terms of herbal production and post-processing (Dumanoğlu et al., 2021). The settings of the tools and machine systems of the producer are made according to these characteristics of the seeds. Because for a successful planting, it is possible to determine the amount of seed to be thrown into the field unit (Özkurt and Karadağ, 2020) and to distribute the seeds uniformly in horizontal (area) and vertical (depth) planes (Dumanoğlu and Çakmak, 2013). Thus, it is aimed to prevent the negativities (gap and twinning) that may occur during transplantation. Likewise, in the product processing step, these seed properties (shape-size, surface area, average arithmetic-geometric diameter, sphericity, thousand grain weight) are used in many process steps such as taking seeds from the

products coming to the agricultural business, cleaning, classifying and separating them according to their sizes. Yağcıoğlu (2015) stated that seeds are separated according to their shape (round-oval-long) and geometric (long-medium-short) characteristics (Table 1).

Table 1. Classification of seeds according to their geometric and shape features

Seeds according to their geometric features	Grain width / Grain length (b/a) (mm)	Seeds according to shape characteristics	Length (a), Width (b), Thickness (c) (mm)
Long	0.6	Round	a ≈ b ≈ c
Middle	0.6 – 0.7	Oval	a/3 < b ≈ c
Short	> 0.7	Long	c < b < a/3

While stereo microscope is used to determine some properties of seeds belonging to jute varieties, data such as length and width of seeds are used to determine average arithmetic diameter-geometric diameter and sphericity values. It is determined in these data of seeds with the help of the formulas given below (Mohsenin, 1970; Alayunt, 2000; Kara, 2012).

$D: (L + W)/2$ (1)

D: Average arithmetic diameter of the seed (mm)
L: Seed length value (mm)
W: Seed width value (mm)

$Do: (L * D\text{^}2)^1/3$ (2)

D_0: Average geometric diameter of the seed (mm)
L: Seed length value (mm)
D: Average arithmetic diameter of the seed (mm)

$\Phi: Do/L$ (3)

Φ: Sphericity Value of the Seed
Do: Average geometric diameter of the (mm)
L: Seed length value (mm)

Another feature to seeds is; thousand grain weight. The weight of each seed grain differs from each other. Many situations such as its location on the plant, the amount of plant nutrients benefiting from, the distance to other plants around it, the effect of environmental and climatic factors affect the seed weight. For this reason, when determining the thousand grain weights of the seeds, sampling should be done from the heap where the seeds are located, and then the seeds should be counted and weighted to represent the whole seed group. In this research, the seeds of the jute varieties were randomly sampled and the counts of thousand were completed in triplicate. Weighing operations were carried out using Radwag AS 220.R2 analytical balance with a sensitivity of 0.0001 g (Dumanoğlu and Geren, 2020).

Some physiological properties of jute seeds

Seeds allocated for vegetative production may change their germination capabilities depending on time and storage conditions (Ceylan, 1997). For this reason, it is necessary to take samples from existing seeds and germinate before each production period (Dumanoğlu et al., 2019). Thus, the producer can make an estimate of the yield to be obtained during the production period. Of course, the production conditions are one of the factors that directly affect the yield, but one of the most important production inputs, the high germination ability and the health of its seed is among the requirements of quality and standard production. In this study, seeds of two different jute varieties (*C. capsularis* and *C. olitorius*) were germinated in glass petri dishes under controlled conditions in laboratory conditions at a temperature of about 20-30 °C and 70% humidity in four repetitions in accordance with the rules of ISTA (2007). The average germination time (days) and percentage (%) of the seeds were determined. In addition, 100 plants were randomly sampled, with 25 plants in each variety, and their shoot-root lengths (cm) were measured.

RESULTS and DISCUSSION

Some physical properties of jute seeds

In this study, seeds of jute varieties (*Corchorus capsularis* and *Corchorus olitorius*) were examined. According to the data obtained respectively, average length values are 1.217 mm and 1.469 mm; mean width values were determined as 0.878 mm and 0.865 mm, and surface area values were determined as 0.689 mm^2 and 0.907 mm^2 (Table 2). According to these values, it was determined that *C. capsularis* variety has a short and oval structure, while *C. olitorius* variety has a medium and oval structure. Kitis and Kaya (2018) stated in their study that jute seeds are generally amorphous seeds with a length of 2-3 mm. However, the seed lengths examined in this study are well below this measure. This is an indication that the shape and size of the seeds change depending on the cultivation of the examined seeds, variety characteristics and climatic conditions. The mean arithmetic diameter values of *C. capsularis* and *C. olitorius* jute varieties were calculated as respectively 1.047 mm and 1.167 mm, the mean geometric diameter values were 0.450 mm and 0.681 mm, respectively, and the mean sphericity values were calculated as 0.367 and 0.457. When we examined these values, the *C. capsularis* obtained lower values than the *C. olitorius* (Table 2).

Table 2. Some physical properties of jute seeds

Seed Features		Jute (*C. capsularis*)	Jute (*C. olitorius*)
Length (mm)	Min.	0.873	0.396
	Avg.	1.217	1.469
	Max.	1.468	1.776
	Stdv.	0.102	0.173
Width (mm)	Min.	0.626	0.612
	Avg.	0.878	0.865
	Max.	1.074	1.132
	Stdv.	0.092	0.112
Surface area (mm^2)	Min.	0.477	0.611
	Avg.	0.689	0.907
	Max.	0.899	1.151
	Stdv.	0.084	0.116
Average arithmetic diameter of the seed (mm)	Min.	0.837	0.698
	Avg.	1.047	1.167
	Max.	1.224	1.350
	Stdv.	0.070	0.097
Average geometric diameter of the seed (mm)	Min.	0.210	0.064
	Avg.	0.450	0.681
	Max.	0.733	1.040
	Stdv.	0.090	0.161
Sphericity of the seed	Min.	0.234	0.162
	Avg.	0.367	0.457
	Max.	0.499	0.608
	Stdv	0.049	0.072
Thousand grain weight (g)	Min.	2.060	2.400
	Avg.	2.070	2.500
	Max.	2.080	2.570
	Stdv.	0.010	0.080

In this study, thousand grain weights of two different jute varieties (*C. capsularis* and *C. olitorius*) examined were weighed as respectively 2.070 g and 2.500 g. The fact that the seeds of the *C. olitorius* variety have a weight of one thousand grains about 0.500 g more than the other variety shows that the seeds of this variety have a slightly heavier structure (Table 2).

Some physiological properties of jute seeds

In this study, germination abilities of two different jute varieties (*C. capsularis* and *C. olitorius*) were also examined. According to the data obtained as a result of the examinations made under controlled conditions; It was determined that 74.5% of the seeds of *C. capsularis* and 63.5% of the seeds of *C. olitorius* were germinated. For a commercial crop production, seeds are generally desired to have a germination capability of over about 70-75% (Ceylan, 1997). For this reason, it was determined that the seeds of the *C. capsularis* variety evaluated in this study had better germination abilities. On the other hand, both varieties were found to germinate at similar day lengths (Table 3).

Table 3. Some physiological characteristics of jute varieties

Seed Features	*C. capsularis*	*C. olitorius*
Germination percentage (%)	74.5	63.5
Average germination time (day)	1.60	1.63
Average shoot length (cm)	2.38	2.41
Average root length (cm)	1.94	4.15

Shoot-root lengths of 100 selected plants of both varieties examined were also measured. According to the data obtained; while the shoot lengths of *C. capsularis* (2.38 cm) and *C. olitorius* were close to each other root lengths were significantly different (1.94 cm, 4.15 cm) (Table 3).

RESULT

In recent years, the use of natural and recyclable environmentally friendly products from petrochemical products has been increasing. These products that are respectful to nature are sometimes considered as a whole and sometimes in composite materials. Jute is an herbal product that is evaluated in this sense. According to the data obtained, it was determined that the *Corchorus capsularis* has a short and oval structure, while the *Corchorus olitorius* has a medium and oval structure. In addition, 74.5% of *C. capsularis* seeds and 63.5% of seeds of *C. olitorius* have germination ability. On the other hand, it was determined that the shoots of the *C. capsularis* and the roots of the *C. olitorius* were longer.

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