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SOYBEAN SEEDS AND AMBROSIA WEED PHYSICAL PROPERTIES

Tarek FOUDA, Asaad DERBALA, Adel HELAL, Amina ALBEBANY

Tanta University, Faculty of Agriculture, Agriculture Engineering Department, Egypt
Phone: +201000350643 and Fax: 0020403455570, E-mails: tfouda628@gmail.com, asaadderbala@yahoo.com, adelra99@yahoo.com, and, amina.elbebany2015@yahoo.com

Corresponding author: tfouda@yahoo.com and tfouda628@gmail.com

Abstract

The experimental work was carried out through 2018 at laboratory of agriculture engineering department, faculty of agriculture Tanta University, Egypt to investigate physical properties of the American soybean seeds and Ambrosia weed were imported to Egypt. These properties can be used in design and development of handling, transporting storage and separating equipment. The seeds dimensions tested under four different moisture content 10, 12, 14, and 16% (wet basis). The results showed, the change in moisture content from 10 to 16% the average dimensions of soybean seeds were changed respectively, the length from 5.60 to 6.57 mm, width from 4.91 to 5.73 mm, thickness changed from 4.11 to 4.73 mm, volume from 62.13 to 96.13 mm^3, geometric mean diameter from 4.83, to 5.62 mm and the arithmetic mean diameter changed from 4.9 to 5.7mm. The differences on sphericity altered from 86.27 to 85.12%. Similarly surface area changed from 21.99 to 29.95 mm^2. Also, the average dimensions of ambrosia weed ranged according imported place the length ranged from 5.20 to 7.53mm, width from 2.46 to 4.00 mm, thickness from 1.57 to 2.97 mm, volume from 11.05 to 41.72 mm^3, geometric mean diameter from 3.10 to 4.70 mm, the arithmetic mean diameter from 3.10 to 4.70 mm, and sphericity from 50.16 to 70.14 %. Also, surface area ranged from 23.9 to 57.99 mm^2. This results revealed the dissimilarities between soybean and ambrosia physical properties that appear in length, width and thickness, this case lead to obstructing separation processes.

Key words**:** *soybean, physical, properties, ambrosia and moisture content*

INTRODUCTION

Soybean (*glycin max*) is one of the main food sources of legume family in human and animal nutrition. which have relatively high protein content in the seeds approximately 40% and oil content 20%. The total production of soybean in the world 334 million tones .and the cultivated area in Egypt was 30,000 ha with total production 45,165 tones according to FAO 2017 [5].

The information about the agricultural products like the physical, mechanical and aerodynamic properties are important and necessary in design of different machines and equipment using for, handling, cleaning, transporting and storage. [1], [3], [10] and [12]

Four different varieties of soybean were determined the physical properties the resulted showed the mean sphericity were 0.745, 0.857, 0.830, and 0.829 respectively. It is shown from the statistical analysis that there is significant difference between the sphericity of all varieties at a probability level of 0.05% The solid densities of all the varieties were ranged from 1,079.5 to 1,170 kg/m^3[7].

The physical and mechanical properties of soybean at 8 to 16% moisture content. In this moisture range, grain dimensions such as length, width, thickness, arithmetic average diameter and geometric average diameter increased from 7.24 to 8.19, 6.79 to 7.12, 5.78 to 6.23, 6.60 to7.18, and 6.57 to 7.14 mm, respectively. The volume of grain and area of grain surface increased linearly from 130.97 to 160.32 and from 125.46 to 144.39 mm2, respectively. The sphericity, bulk density, true density and porosity decreased linearly from 0.91 to 0.87, 766.12 to719.00, 983.33 to 905.67 kg m-3 and 22.58 to 20.61%, respectively. The friction angle increased from 27.37 to 31.81° with the increase of moisture content. The static coefficient of friction increased from 0.385 to

0.571, 0.304 to 0.441 and 0.164 to 0.286 for concrete, wood and galvanized steel surfaces, respectively [6].

Soybean (*Glycine Max*) member from the Fabaceae family, namely it is prone to mechanical damage occurring during threshing, cleaning, drying, storage and transportation,. Information of the physical properties of soybean seeds mainly important for the optimization of harvesting, drying and storing processes, as it translates into minimization of losses and mechanical damage. [9]

Soybean physical properties such as length, width, thickness and thousand mass recorded 6.55 mm, 5.56 mm, 4.53 mm and 103.57 g, respectively, at moisture content of 7.37% (dry basis). When moisture content increased from 7.37% to 15.80% (db) the geometric mean diameter increased from 5.44 to 5.57 mm and the sphericity varied between 0.83 and 0.84 [11].

The influence of moisture content on physical properties (seed dimension, geometric mean diameter, individual seed weight, sphericity, bulk and true density, porosity angle of repose and static coefficient of friction of knotweed (Polygonum cognatum Meissn.) seeds were investigated. Moisture contents of seeds were 7.95, 13.68 and 19.14% d.b. (dry basis), respectively [8].

Common ragweed (Ambrosia artemisiifolia L.) is a competitive weed in soybean fields Ambrosia densities of 2, 6, and 12 m^{-1} row resulted in soybean yield losses of 76, 91, and 95% in 2015 and 40, 66, and 80% in 2016, respectively [4].

Big problem face the separating and cleaning plant in Egypt when imported the soybean a lot of weed similar with seed thus cleaning and separating machine must adjusted to remove all weed. So the main objective of this research to describe the changes between soybean and ambrosia physical properties

MATERIALS AND METHODS

Experiment was carried out through 2018 at laboratory of agric. Eng. dept. Tanta University, to investigate physical, properties of the American soybean seeds imported to Egypt. These properties used in design and development of separating machine of the soybean seeds and ambrosia weed. The seeds and weed dimensions tested under four different moisture content 10,12,14, and 16%

Soybean crops

American soybean seeds as showing in Fig.1 was used in this study, and Ragweed (*Ambrosia Artimesifolia***)** weed seeds as showing in Fig.2.

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Fig.1. American Soybean seeds
Source: Author's own illustration.

Fig.2. Ragweed(*Ambrosia artemisiifolia)*seeds
Source: Author's own illustration.

Measurements and determinations.

-Moisture content

Moisture content soybean seeds was determine as by dried in an oven of 103°C for 24h. All moisture percentages were determined on wet basis as it showed in equations below:

$$M_w = (W_2 - W_1)/W_2 \times 100 \quad (1)$$

where: M_w: Moisture content of soybean seeds sample on wet basis, (%),

W_1: Final mass of soybean seeds sample after drying, (g) and

W_2: Initial mass of soybean seeds sample before drying, (g).

-Axial dimensions of seed

A sample selected 100 seeds randomly. The three axial dimensions of seed are namely length L, in mm (longest intercept), width W, in mm (equatorial width perpendicular to L) and thickness T, in mm (breadth perpendicular to L and W).

- Physical properties

Different physical of soybean seeds were determined. Mean dimensions of soybean seeds, were calculated from this equations:

-Arithmetic mean diameter (D_a), mm:

$$D_a = \frac{(x + y + z)}{3} \quad (2)$$

-Geometric mean diameter (D_g), mm:

$$D_g = (x.\ y.\ z)^{1/3} \quad (3)$$

-Surface area (A_s), mm^2:

$$A_s = \pi., D_g^2 \quad (4)$$

-Volume (V), mm^3:

$$V = \frac{\pi}{6}(x.\ y.\ z) \quad (5)$$

-Sphericity (φ), %:

$$\varphi = \frac{(x.y.z)^{1/3}}{x} = \frac{D_g}{x} \quad (6)$$

where: x: length of grains (mm),
y: width of grains (mm) and
z: thickness of grains (mm)

-Density: $\rho = m/v$ ($gm./cm^3$) (7)

where: m= Mass of sample,(gm.)
v = Volume occupied by the sample, (cm^3).

-Surface area: $S_a = \Pi (D_g)^2$ (8)

RESULTS AND DISCUSSIONS

Effect of moisture content on physical properties of soybean seeds.

The values of seed length linearly increased from 5.60 to 6.57 mm with increase moisture content from 10 to 16% (wb) (Fig. 3).

Linear relationship was obtained between moisture content (Mc) and seed length:

$$y = 0.336x + 5.27 \qquad R^2 = 0.9987 \quad (9)$$

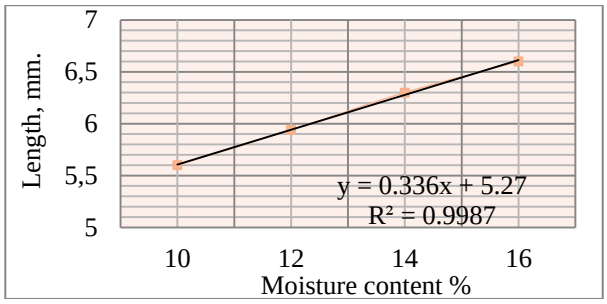

Fig.3.Relationship between moisture content and seed lenght.
Source: Author determination.

The values of seed width linearly increased from 4.91 to 5.73 mm. with increase moisture content from 10 to 16% (wb) (Fig. 4).

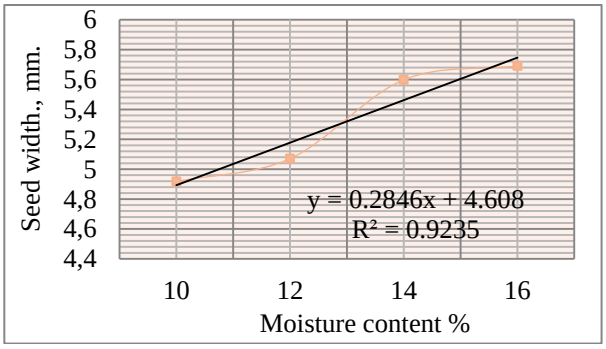

Fig.4. Relationship between moisture content and seed width.
Source: Author determination.

Linear relationship was obtained between moisture content (Mc) and seed width.

$$y = 0.2846x + 4.608 \qquad R^2 = 0.9235 \quad (10)$$

The values of seed thickness linearly increased from 4.20 to 4.65 mm. with increase moisture content from 10 to 16% (wb) (Fig. 5).

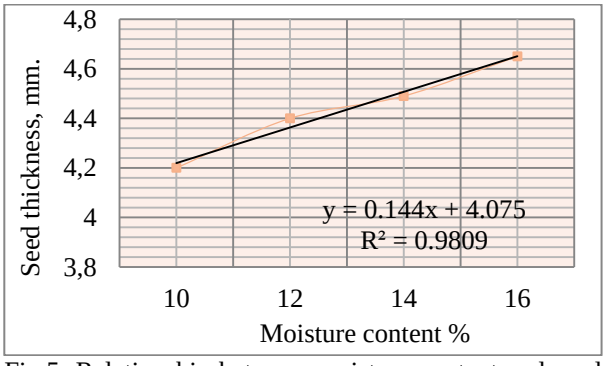

Fig.5. Relationship between moisture content and seed thickness.
Source: Author determination.

Linear relationship was obtained between moisture content and seed thickness

$y = 0.144x + 4.075 \quad R^2 = 0.9809 \quad (11)$

Similar increasing for length, width and thickness of seed, seam trends have been reported for soybean seed. [2] The positive linear relationship of seed width and moisture content were also reported by [11] for soybean. Volume of seed showed linearly increased from 62.13 to 93.90 mm^3 with increase moisture content from 10 to 16% (wb) (Fig. 6).

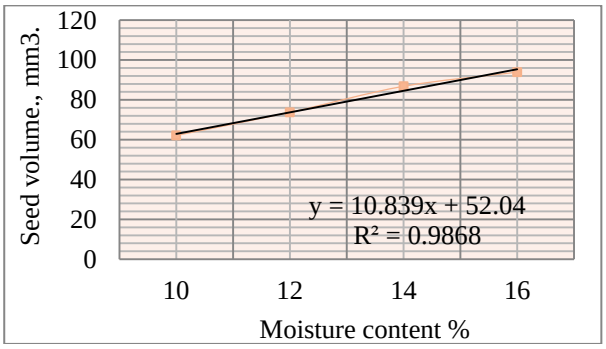

Fig.6.Relationship between moisture content and seed volume.
Source: Author determination.

Linear relationship was obtained between moisture content and seed volume.

$y = 10.839x + 52.04 \quad R^2 = 0.9868 \quad (12)$

Seed arithmetic diameter fluctuated from 4.883 to 5.642 mm. when moisture content increased from 10 to 16% as showing in Fig.7. Linear relationship was ound between moisture content and seed arithmetic diameter.

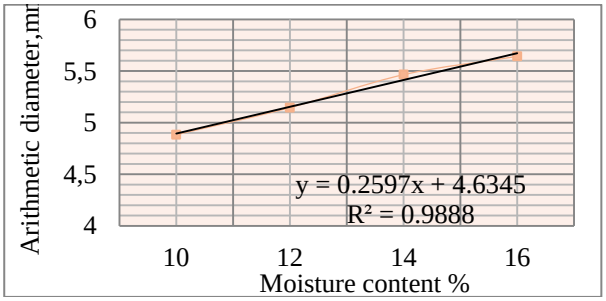

Fig.7. Relationship between moisture content and seed arithmetic diameter.
Source: Author determination.

$y = 0.2597x + 4.6345 \quad R^2 = 0.9888 \quad (13)$

Fig. 8 seed geometric diameter increased from 4.83 to 5.57 mm when moisture content increased from 10 to 16%. Linear relationship was obtained between moisture content and seed arithmetic diameter.

$y = 0.248x + 4.59 \quad R^2 = 0.9984 \quad (14)$

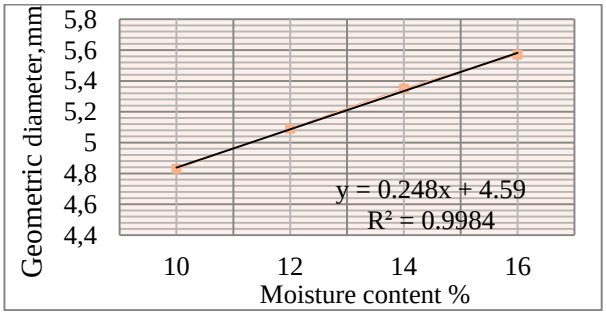

Fig.8.Relationship between moisture content and seed geometric diameter.
Source: Author determination.

Fig. 9 seed sphirecity ranged from 86.27 to 85.12% when moisture content increased from 10 to 16%. Linear relationship was obtained between moisture content and seed sphirecity.

$y = -0.385x + 86.71 \quad R^2 = 0.9852 \quad (15)$

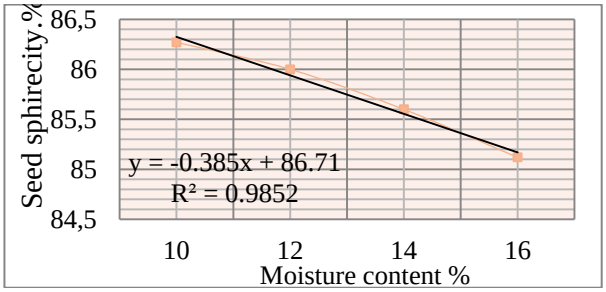

Fig.9. Relationship between moisture content and seed sphirecity.
Source: Author determination.

The result in Fig. 10 indicates that the soybeans flat surface area increased with 21.99, 24.02, 28.19 and 29.71 mm^2 when moisture content increased by 10,12,14, and 16% . The relationship of flat surface area and moisture content can be expressed using regression equation as:

$y = 2.733x + 19.145 \quad R^2 = 0.9686 \quad (16)$

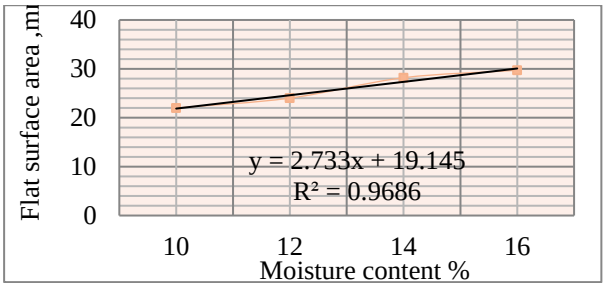

Fig.10. Relationship between moisture content and seed flat surface area.
Source: Author determination.

The transfer surface area of soybean increased by 16.08 17.94 19.98 and 20.96 mm^2 respectively, as moisture content increased by 10, 12, 14, and 16% (Fig.11). The relationship of transfer surface area and moisture content can be expressed using regression equation as:

$y = 1.668x + 14.57 \quad R^2 = 0.9809 \quad (17)$

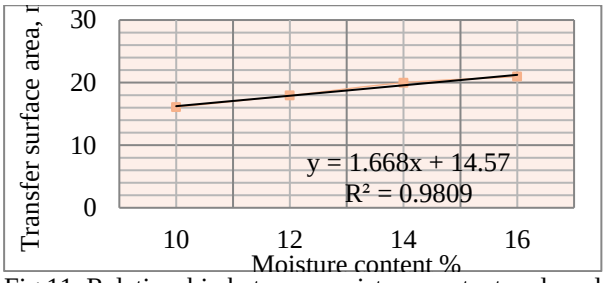

Fig.11. Relationship between moisture content and seed transfer surface area.
Source: Author determination.

The surface area of soybean increased by 73.27, 81.36, 91.5 and 97.42 mm^2 respectively, as moisture content increased by 10,12,14, and 16% (Fig.12).
The relationship of transfer surface area and moisture content can be expressed using regression equation as:

$Y = 8.2602x + 65.238 \quad R^2 = 0.9909 \quad (18)$

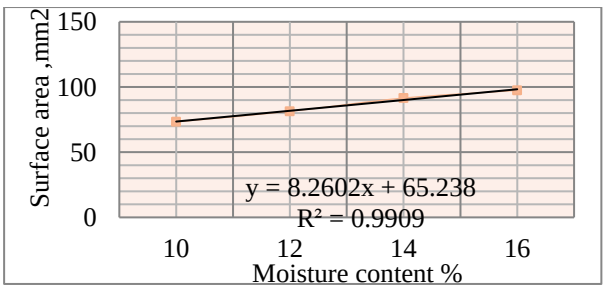

Fig.12.Relationship between moisture content and seed surface area.
Source: Author determination.

Physical properties of ambrosia weed seeds

The average length, width and thickness of ambrosia weed fluctuated from 5.20 to 7.53 to 6.57 mm, 2.46 to 4.00 mm and 1.57 to 2.97 mm also volume ranged from 11.05 to 41.72 mm^3 as maximum and minimum value respectively.
The arithmetic diameter, ranged from 3.10 to 4.70 mm. and geometric mean diameter increased from 2.76 to 4.29 mm.
The surface area increased from 23.9 to 57.99 mm^2 and the sphericity increased from 50.16 to 70.14% with maximum and minimum value respectively. As showing in Table 1.

Table 1. Some physical properties of ambrosia weed seeds

Parameter	Value
Length, mm	5.2-7.53
Width, mm	2.46-4.00
Thickness, mm	1.57 - 2.97
Volume, mm^3	11.05 – 41.72
Arithmetic diameter, mm	3.10-4.70
Geometric diameter, mm	2.76-4.29
Sphericity %	50.16-70.14
Surface area, mm^2	23.9-57.99

Source: Author determination.

The differences between the physical properties of ambrosia and soybean

The average length, width and thickness of ambrosia weed and soybean alternated from 7.53 to 7.62 mm, 6.18 to 4.00 mm and 2.97 to 5.90 mm also volume ranged from 41.72 to 119.00 mm^3 as maximum and minimum value respectively. The arithmetic diameter, extended from 4.70 to 6.20 mm and geometric mean diameter fluctuated from 4.29 to 6.10 mm. The surface area alternated from 57.99 to 35.89 mm^2. At a constant moisture content, 12% as showing in Fig. 13.

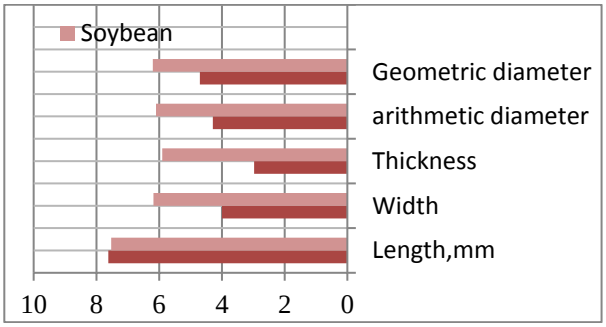

Fig. 13. The differences between some physical properties of ambrosia and soybean
Source: Author determination.

CONCLUSIONS

The soybean grains length, width and thickness change as moisture content ranged from 10% to 16% (wb), the grains length increased from 5.81 to 6.57 mm, width and thickness change from 4.91 to 5.69 mm and 4.11 to 5.53 mm respectively. The geometric mean diameter increased from 4.83 to 5.27 mm. and the sphericity increased from 0.8627 to 0.8512 with the increase in moisture content from 10% to 16% (wb).

The ambrosia grains length, width and thickness recorded value were 6.31 mm, 3.44 mm and 2.29 mm respectively. The geometric mean diameter detailed at 3.66 mm. and the sphericity were 0.5815

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