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Some Physical-Mechanical Characteristics Of Sesame Plants

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Abstract: The geometric parameters of the promising sesame variety Tashkent - 112 were studied, as well as the sliding friction angles of its main parts on stainless, steel and plastic surfaces using a special stand. The friction angle values of sesame stalks ranged from 21.6° to 41.8°, the lowest values were found in the range from 20.40 to 24.50 on the surface of stainless steel, the difference was 17%. The value of the friction angle decreased by 5.5% during the transition from technological maturation to standard maturation. It has been established that the friction angle of stems located longitudinally in relation to the inclination of the plate is greater than the angle with a transverse arrangement by 5.5% at technological ripeness and by 7.2% at standard ripeness.

Seed moisture content during the transition from technological to conditional ripening decreased from 18.3% to 8.5%. The friction angle values of seeds of technological and standard maturity ranged from 22.00 to 31.00 and from 21.60 to 32.50, respectively, the difference between them was 4.5%.

Keywords: Mechanization, Sesame, Geometric Properties, Mechanical Properties.

1. Introduction

Depending on the varietal characteristics of sesame, the difference between the ripening of seeds in the lower and upper parts is 2-4 weeks, as a result of which the lower seeds fall off before the upper seeds ripen, which is the main obstacle to mechanization of harvesting. In order to reduce seed loss, in many leading countries of the world, sesame plants are mowed by hand, and after about 2-3 weeks, when the seeds at the top of the plant ripen, the seeds are extracted using various threshing machines, which accounts for about 80% of the cost of growing sesame. The development of technical means for sesame harvesting, which significantly reduce grain losses, time, labor and other costs, is one of the ways to solve problems associated with sesame harvesting [1,2].

The geometric dimensions of the main parts of plants and the angles of their friction on the surfaces of various materials are considered important physical and mechanical properties. These parameters have a significant impact on the process of their interaction with the working parts of the machines and will depend on the type of crop, variety, yield and agrotechnical practices.

The physical and mechanical properties of sesame stems, bolls and seeds are the basis for the design of sesame harvesting devices. During the ripening process of sesame seeds, their physical properties, including surface layer and moisture content, change significantly, and this affects the sliding angles.

The purpose of the study - determine the geometric properties, angles of friction on the surface of various materials of the main parts of sesame plants at technological and conditional ripeness.

Volume 34,December 2024
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2. Method and materials

Geometric dimensions and sliding friction angles of the main parts of sesame plants: stems, fruit bolls and seeds of the local sesame variety "Tashkent-112".

The measurements were carried out in the laboratory of mechanization of harvesting processes of the Scientific-Research Institute of Agricultural Mechanization. To conduct research at the experimental site of the institute, the local sesame variety "Tashkent-112" was sowed according to the pattern 50x20x50 cm. The seeding depth was 1.5-2 cm, and the seeding rate was an average of 700 thousand pieces per hectare (photo 1).

2.1. Preparation of samples for research

The sesame seeds used in the experiments were obtained from the 2023 harvest, grown at the institute's experimental field. The plants were delivered to the laboratory whole and were divided into three equal parts. To avoid damage, the seeds were removed from the pods by hand. Due to the fact that harvesting is carried out in a two-phase manner, the moisture content in the main parts of plants was determined in a standard way during the period of their technological and conditional ripeness. 100 seeds were randomly selected for the samples [3].

a)

б)

c)

Photo 1. Sowing sesame seeds (a), inter-row cultivation (b) and ripening period (c)

2.2. Instrumentation

The length, width and thickness of sesame seed samples were measured using a Themisto TH-M61 digital caliper. It has a measuring range of 0-150mm with a measuring accuracy of ±0.02mm. An Idealforce electronic scale (200 g x 0.01 g) manufactured in the USA was used to weigh sesame seed samples.

2.4. Determination of geometric properties of sesame seeds

After measuring the seed size (L, mm), weight (W, g) and thickness (T, mm), geometric parameters were calculated: volume (V, mm^3), percentage of sphericity (S, %), geometric (D_g, mm) and arithmetic (D_a, mm) diameters, flat (A_f) and transverse (A_t) surface areas according to the following expressions [4].

$$D_g = (L \times W \times T)^{1/3} \quad (1)$$

$$D_a = \frac{(L + W + T)}{3} \quad (2)$$

$$S = 100 \cdot \frac{(L \times W \times T)^{3/1}}{L} \quad (3)$$

$$V = \frac{\pi}{6}(L \times W \times T) \quad (4)$$

$$A_t = \frac{\pi}{4}(W \times T) \quad (5)$$

$$A_f = \frac{\pi}{4}(L \times W) \quad (6)$$

Bulk density of seeds (B_d) was calculated by dividing the mass of seeds by their volume. In this case, to determine the volume of seeds, a cylinder of the same volume was used.

$$B_d = \frac{W_b}{V_b} \quad (7)$$

Where - B_d – bulk density of seeds, kg/m^3,
W_b – mass of seeds of the same quantity, kg,
V_b – volume of seeds of the same quantity, m^3.

The weight of 100 seeds (K_m, g) was determined using electronic scales.

2.4. Angles of friction of seeds of the local variety "Tashkent-112" on various surfaces.

The measurements were carried out using a special device (Figure 1). It consists of a table 1, a surface for determining the angle of friction 2, an inclination angle meter 3, a metal base in the form of a frame designed for fastening surfaces made of various materials 4, a handle 5, a hinge 6, a screw 7 and a nut 8 for changing the inclination of the surface. Steel, stainless and plastic surfaces are attached to the base 4 using special screws.

Before starting measurements, surface 2 and table 4 are brought to a horizontal position and the material to be studied is laid out on the surface in one layer. Slowly turning screw 7, we increase the angle of inclination until the material begins to slide

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along surface 2. Determining the friction angle on a scale 3. After each measurement, the surface is thoroughly cleaned of dust and other particles. The measurements are carried out in triplicate and the average value of the friction angle is read.

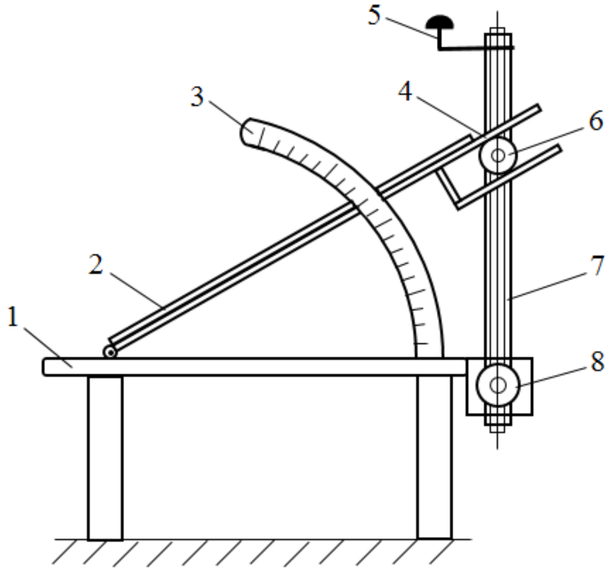

Figure 1. Scheme of a stand for determining the sliding friction angle.
1 - table, 2 - surface on which the friction angle is determined,
3 - scale for measuring the angle of inclination, 4 - frame designed for fastening surfaces made of different materials, 5 - handle, 6 - hinge, 7 - tilt adjustment screw, 8 – nut.

3. Results and Discussion

3.1. Geometric properties of sesame seeds

In the studies, the average height of technologically ripe sesame plants was 103 cm, the diameter of the stem at a height of 10 cm from the surface was 55 mm, the average number of bolls per bush was 33.2 pieces, the average number of seeds in one boll was 59.4 pieces.

According to research results, the average sizes of sesame seeds are: length (L) = 2.6 mm, width (W) = 1.7 mm and thickness (T) = 0.9 mm (Figure 2).

From Figure 2, it can be seen that the frequency was 66% for a length of 2.6 mm, 58% for a width of 1.7 mm, and 62% for a thickness of 0.9 mm.

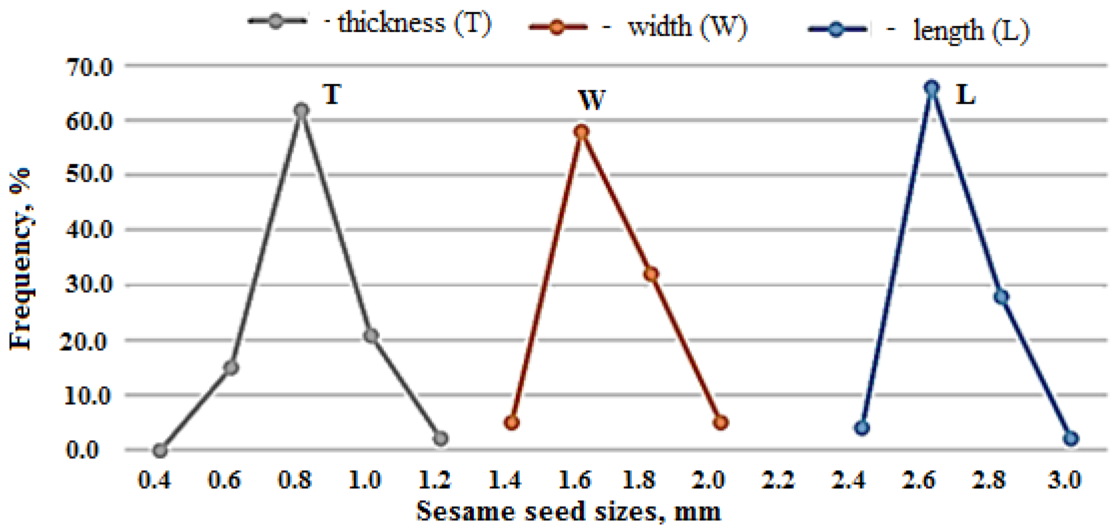

Figure 2. Frequency of changes in sesame seed sizes.

Certain geometric parameters of sesame seeds according to the calculation results are presented in Table 1. From Table 1 it can be seen that the flat surface area of sesame seeds and the transverse surface area are 3.22 and 1.21 mm^2, respectively, the mass of 100 seeds is 0.31 g, and the volume - 2.27 mm^3.

Table 1. Geometric properties of sesame seeds.

Parameters of seeds	Average values	S.D	C.V, %
L	2.6	0.17	6.54
W	1.7	0.15	8.82
T	0.9	0.07	7.78
V	2.27	0.19	8.37
S	60.96	1.82	2.98
D_g	1.59	0.082	5.16
D_a	1.33	0.084	6.31
A_f	3.22	0.32	9.93
A_t	1.21	0.13	10.74
K_m	0.31	0.02	6.45

3.2. Angles of friction of seeds of the local variety "Tashkent-112" on various surfaces.

The moisture content in the main parts of sesame is presented in Table 2. During the transition from technological ripening to standard ripening, the moisture content of stems, bolls and seeds decreased by 57%, 63% and – 56%, respectively.

Table 2. Moisture content of sesame plants, [%].

At technological ripeness			At standard ripeness		
stems	capsules	seeds	stems	capsules	seeds
25.5	19.2	18.3	14.5	12.1	8.5

The friction angles of sesame stems on the surface of various materials are presented in Table 3. The angle values ranged from 21.6° to 41.8°. The smallest angle values were determined for the stainless steel surface in the range from 20.4 to 24.5 mm, and the difference was 17 %. The value of the friction angle decreased by 5.5 % during the transition from technological maturity to standard maturity.

The friction angle of the stems in the transverse position relative to the inclined surface differed from that in the longitudinal position and was 5.5 % and 7.2 % greater at technological and conditional maturity, respectively.

Table 3. Friction angles of sesame stalks on different surfaces, [°].

Surface type	transversely		longitudinally	
	minimum	maximum	minimum	maximum
at technological ripeness				
Stainless steel	22.8	24.5	21.6	23.7
Metal	31.0	37.5	29.9	31.2
Plastic	34.7	39.6	35.5	41.8
at standard ripeness				
Stainless steel	22.0	24.7	20.4	22.8
Metal	29.3	34.9	27.7	29.3
Plastic	30.5	38.2	34.0	36.5

The friction angles of capsules of technological ripeness varied from 23.0° to 39.4° for different surfaces, the difference was 41.6 %, and during the period of standard maturity – 39 % (Table 4).

Table 4. Angles of friction of seeds and capsules on different surfaces, [°].

Surface type	capsules		seeds	
	minimum	maximum	minimum	maximum
at technological ripeness				
Stainless steel	23.0	26.7	22.0	26.6
Metal	31.5	35.6	27.4	30.5
Plastic	35.2	39.4	29.8	31.4
at standard ripeness				
Stainless steel	22.8	29.7	21.6	27.1

Metal	29.0	33.7	26.2	30.6
Plastic	32.1	37.2	28.5	32.5

During the transition from technological ripening to standard ripening, the moisture content in seeds decreased from 18.3 % to 8.5 %. The friction angle values of technological and conditioned mature seeds ranged from 22.0° to 31.0° and from 21.6° to 32.5°, respectively, and the difference was 4.5 % (Table 4).

The sliding friction angles on a stainless steel surface are significantly different from the friction angles on a surface made of ordinary steel and plastic. It was observed that the friction angle values increased from 30.5° to 41.8° when sesame stems were placed transversely and longitudinally on the plastic surface, respectively. These values are 25-43 % higher than those of ordinary and stainless steel.

The friction angles of the main parts of sesame on different surfaces vary significantly. The greatest difference was found in the arrangement of stems transversely 42 % and longitudinally 47 % on the surface, bolls 41 % and seeds 32 %.

4. Conclusion

The friction angle depends on the maturity of the plant, its location relative to the sliding surface and the type of surface. The friction angle values of sesame stems range from 21.6° to 41.8°. Its lowest values were found in the range from 20.4° to 24.5° on the surface of stainless steel, the difference was 17 %. When moving from technological maturity to conditional maturity, the friction angle decreases by 5.5 %.

The friction angle of the stems located transverse to the surface was greater than that of the longitudinal ones; with technological ripening it was 5.5 % greater, and with conditional ripening - by 7.2 %.

During the transition from technological to standard ripeness, seed moisture decreased from 18.3 % to 8.5 %. The friction angle values of technologically and conditionally mature seeds ranged from 22.0° to 31.0° and from 21.6° to 32.5°, respectively, the difference was 4.5 %.

References

[1] Ravshanov Sh., Bozorboev A., Sherov D., Problems of mechanisation of sesame seed harvesting."Innovative solutions for creating highly efficient agricultural machinery and increasing the efficiency of use of technical means", International scientific and technical conference, September 2023, pp.225-228.

[2] Kossivi Fabrice Dossa, Anselm Anibueze Enete, Yann Emmanuel Miassi, Abiodun Olusola Omotayo. Economic analysis of sesame (Sesamum indicum L.) production in Northern Benin. Frontiers in Sustainable Food Systems. January 2023, pp. 01-16.

[3] Marcos E.V. Araujo, Eloiny G. Barbosa, Felipe A. Gomes ва бошқалар. Physical properties of sesame seeds harvested at different maturation stages and thirds of the plant. Chilean journal of agricultural research, December 2018, pp. 495-502.

[4] Sheraz Zuher Karem, Geometrical Properties of Local Sesame Seeds (Sesamum indicum L.) Grown in Kurdistan Region. Al-Qadisiyah Journal For Agriculture Sciences (QJAS) ISSN : 2618-1479 Vol.13, Issue. 2 ,(2023), pp. 152-157.