

The current state of soybean production and its size-mass indicators in the conditions of Uzbekistan

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Abstract. Soybeans are a valuable crop, yet in Uzbekistan, the cultivation area is small, covering approximately 150,000 hectares. The main reasons are the lack of suitable soybean varieties for the local climate, water scarcity, and competition for land with other crops. Harvesting is a critical process, and in Uzbekistan, combine harvesters are commonly used. To prevent damage during harvesting, it is essential to understand the size-mass indicators of soybeans grown in Uzbekistan. Experiments have shown that the height of soybeans during harvesting varies from an average of 63 to 99 cm, depending on the variety and cultivation methods. The average lower stem diameter ranges from 4.1 to 7.1 mm, and the pod height varies from 15 cm for the Oyjamol and Amigo varieties to 6 cm for the Selekt variety. The height of the plant is 21.0 to 29.8 pods per bush, and the grain-to-stem ratio is 1:1.1 to 1:1.8. These indicators are crucial for adjusting the working parts of harvesters to optimal operating modes, minimizing damage during harvesting. The lack of suitable soybean varieties for the local climate and water scarcity are significant challenges that must be addressed to increase the cultivation area of soybeans in Uzbekistan.

1 Introduction

Ten species make up the *Glycine* L. family, which includes soybeans. However, only one of them, *G. hispida* Maxin, is responsible for growing soybeans. This species is an annual plant with multiple branches, a bulging arrowroot, and a deep root system that can reach up to 1.5-2 meters. The stem is erect, thick, rounded, rough, and can grow to over one meter in height. The pods are straight or curved and hold two to four seeds each [1].

The high level of oil and vegetable protein in soybeans makes this plant one of the valuable plants. Grain contains 40-50 percent protein, 23-25 percent fat and a small amount of carbohydrates. No other vegetable grain contains as much protein and fat together. Soybean grain is used in all sectors of the economy. Around 300 distinct food product

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varieties, technical raw materials and necessary feed for animals, poultry and fisheries are made from it. Milk, yogurt, cheese, flour, meat substitute or meat flavoring products are made from grain. In addition to being a legume, soybean is also an oilseed crop. The oil contains harmful substances for the human body. By processing soybeans, raw materials for soap, paint, alif, varnish and glue, as well as other main and secondary products are obtained [2-4].

Soy beans, along with their stalks, are a plant that belongs to the legume family and is high in protein. Soy grain weighing 100 kg has 138, 52, 22, and 20 kilograms of silage are included in 100 kg of dry hay. Grain contains more digestible protein than other grains and legumes combined. 278 g of digestible protein are found in 1 kilogram of soybeans, compared to 200 in barley, 175 in buckwheat, and 77 in oats [5-13].

There are 150 million oil crops on the planet right now. It is planted over a hectare in size. Among these, soybeans account for 110 million hectares, sunflowers for 25 million hectares, rapeseed, and sugar beets for 15 million hectares. It takes up more than a hectare to grow. The World Food Organization (FAO) reports that the amount of soybeans cultivated worldwide is rising year [14].

Specifically, in the 1960s, 20–30 million if it is grown on a hectare of land; by now, this indicator has surpassed 110 million. Productivity has also gone up in addition. The gross yield in the 1960s was 350–360 million tons, with an average yield of 10–12 tons per hectare. Today, this figure is 20–22 tons per hectare. Soybeans have been cultivated intensively since the 1990s; productive varieties have been developed, and more sophisticated technology for their cultivation have been invented.

A significant increase in the economy of some countries has been observed due to the introduction and increase of soybean cultivation. For this reason, nations all around the world are becoming more interested in cultivating it. In recent years, precision farming and smart agriculture using UAV's have been used in soybean cultivation [15-21].

2 Materials and methods

The countries that grow the largest amount of soybeans in the world were given based on the data of the World Food Organization, and the data on the cultivation of soybeans in Uzbekistan were given based on the data of the Ministry of Agriculture and the State Statistics Agency. Since World Food Organization sources provide more extensive data on world soybean production for the years 2020-2021, the article also provides data for these years. The data for Uzbekistan were obtained in the period of 2021-2022, they were divided by regions and presented in a diagram.

N. Tavakoli and others worked on figuring out the size-mass characteristics of soybeans overseas [22]. The physical and mechanical characteristics of soybeans cultivated in Uzbekistan were ascertained using the techniques described in these studies.

Since the "Amigo," "Selekta-201," and "Oyjamol" kinds of soybeans are cultivated in a larger area in Uzbekistan, their size-mass indicators were examined while determining the size-mass indicators of soybeans (Figures 1 and 2). To measure the size of the soybean and its stem, pod, and grain, researchers employed a roulette wheel, ruler, barbell circle, and computerized scale. The electronic scale has a measuring accuracy of 0.001 g, the roulette and ruler have an accuracy of up to 1 mm, the barbell has a measurement accuracy of 0.01 mm.



Fig. 1. The method of examining the soybean's dimensions.



Fig. 2. The method of examining the soybean's bulk.

Measurements were carried out on 100 plants of each type of soybean. Soybean plant sampling from the field was carried out from 25 locations in both diagonal directions across the field, 0.25 m². From each set of samples obtained, 4 plant samples of different sizes were separated. Following that, measurements were made of their weight, the stem's length and diameter, the lowest pod's height, the number of pods on the stalk, the mass of the pods, the number of grains within the pods, the mass of the grain, and the ratio of the grain to the stem. Using mathematical statistics techniques, the measured indicators were examined and their average value, mean square deviation, and variation coefficients were found.

3 Results and discussion

3.1 Status of soybean cultivation

Brazil, the USA, Argentina, China, India, Paraguay, Canada, Russia, Ukraine, Bolivia, Uruguay and Indonesia are the countries that grow soybeans the most. Brazil has 136 million soybeans. t, 112.55 million in the USA. t, 47.5 million in Argentina. t, 19.6 million in China. t, 10.7 million in India. t, 9.7 million in Paraguay. t, 6.35 million in Canada. t, Russia 4.31 mln. t, Ukraine 3.10 mln. t, 2.85 million in Bolivia. more than tons and 1 million in Uruguay and Indonesia. slightly less than a ton of soybeans is grown (Table 1) [14].

Table 1. Information about the countries that grow the most soybeans.

№	Name of the countries	Amount of soybean, t
1	Brazil	136 000 000
2	the USA	112 550 000
3	Argentina	47 500 000
4	China	19 600 000
5	India	10 700 000
6	Paraguay	9 700 000
7	Canada	6 350 000
8	Russia	4 310 000
9	Ukraine	3 100 000
10	Bolivia	2 850 000

In our republic, soybeans have been cultivated in large areas as the main and recurrent crop in recent years, and it is planned to increase it every year by government decisions.

In 2018, soybeans were planted on a total of 30280 ha in our republic, of which 11100 ha were planted as the main crop and 19180 ha were planted as a secondary crop on the land freed from grain. In 2021, a total of 39617 hectares of soybeans were planted as the main crop. In addition, in Andijan, Namangan, Fergana and Tashkent regions, about 100,000 hectares of soybeans were planted between cotton rows (Figure 3). [7].

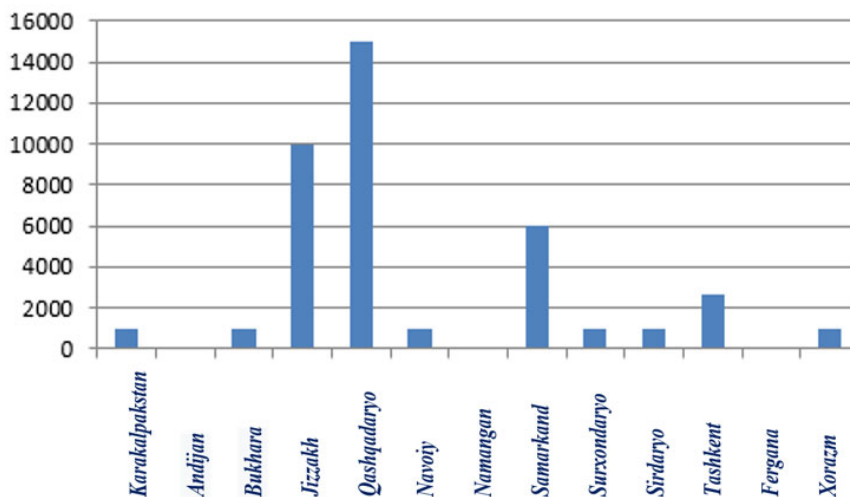


Fig. 3. Soybean cultivation area in regions across the republic.

In 2022, soybeans were planted on 146,500 areas.

3.2 Size-mass markers of soybeans and their grain cultivated in Uzbekistan

The height of the plant varies from 63 to 99 cm on average in the studies conducted on the soybean types "Amigo," "Selekta-201," and "Oyjamol," depending on the cultivar and agrotechnics used. Soybean stems have an average lower diameter of 4.1–7.1 mm. In the field where the Oyjamol and Amigo varieties were planted, it was discovered that the lowest half of the pods' height was above 15 cm, whereas the pods in the Selekta variety's planted field were below (6 cm high). There were, on average, 21.0–29.8 pods per plant. The main grain to stem ratio was found to be between 1:1 and 1:1.8. Table 2 displays the findings from the size-mass analysis of soybeans.

Table 2. Size-mass metrics for soybeans.

Name of indicators	Sorts of soybean					
	Selekta-201		Oyjamol		Amigo	
	X	±σ	X	±σ	X	±σ
Length of crop, mm	630	83	990	119	850	136
Thickness of the stalks, mm	4.1	0.8	6.8	2.8	7.1	0.37
Overall of the crop mass, g	14.8	4.4	20.3	6.3	17.7	9.7
The height leg's near soil, mm	62	14	154	26	167	28
Amount of pods, pcs	21.0	6.0	26.6	7.8	29.8	16.1
The weight of the pod, g	11.5	2.9	12.7	4.6	10.4	6.0
Average amount grains in a pod, pcs	2.3	0.8	2.4	1.1	2.3	1.1
Grain weight in pods, g	7.4	2.6	7.3	2.6	6.3	3.8
The ratio of the grain to stems	1:1	-	1:1.7	-	1:1.8	-

In the "Amigo" variety, the grains range in length from 6.2 mm to 9.1 mm, in width from 5.6 mm to 7.2 mm, and in thickness from 4.2 mm to 6.1 mm. In the "Selekta-201" variety, the grains range in length from 6.8 mm to 9.8 mm, in width from 5.7 mm to 7.9 mm, and in thickness from 4.7 mm to 6.9 mm. In the "Oyjamol" variety, the grains were found to vary in width from 5.7 mm to 7.7 mm and thickness from 4.5 mm to 6.9 mm.

4 Conclusion

In Uzbekistan soybeans have been cultivated in large areas as the main and recurrent crop in recent years, and it is planned to increase it every year by government decisions. In 2018, soybeans were planted on a total of 30280 ha in our republic, of which 11100 ha were planted as the main crop and 19180 ha were planted as a secondary crop on the land freed from grain. In 2021, a total of 39617 hectares of soybeans were planted as the main crop. In addition, in Andijan, Namangan, Fergana and Tashkent regions, about 100000 hectares of soybeans were planted between cotton rows. The study of biometric parameters of soybean showed that the branching growth of the plant, the hardness of the stems compared to the pods, and the large mass of the stem compared to the mass of the seed make it somewhat difficult to harvest. The low location of the pods requires harvesting soybeans at a relatively low mowing height. This causes the working bodies of the harvester, threshing, grain separation and cleaning to work under some load.

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