

Evaluation of yield and yield attributes traits of soybean (*Glycine max* L. Merr.) varieties in Uzbekistan

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Abstract

In the article, Assessment of local and foreign soybean varieties transpired during 2020–2022, for yield-related traits, at the Samarkand and Navoi regions of Uzbekistan. The soybean cultivars, grown in a randomized complete block design, had a factorial arrangement with three replications. The data were documented on ten plants selected at random from each entry of each replication for the number of pods per plant, the number of seeds per plant, 1000-seed weight and seed yield. The data were scrutinized statistically using the analysis of variance of Fisher's technique and least significant difference (LSD) test at the 5% level of probability. When the yield and yield attributes of local and foreign soybean varieties in the Samarkand and Navoi regions were studied, local Ustoz-MMAAn-60 and Tomaris-MMAAn-60 soybean varieties showed positive results compared to other varieties for the field conditions of the Samarkand region, while Navoi For the field conditions of the region, Sparta and Oyjamol varieties showed higher indicators compared to other varieties. In the experiment, it was found that some foreign soybean varieties are positive in yield traits of productivity in the region of Uzbekistan.

Keywords: Soybean, local, foreign, yield, pod, seed

Introduction

Soybean (*Glycine max* L. Merr.) is an important legume crop globally with Brazil (38% of total global production in 2021), the USA (31%), and Argentina (13%) being the major producers (SoyStats, 2022). Soybean is widely grown as an oilseed and a protein source worldwide (Chen et al., 2013; Govindasamy et al., 2017) Because of their high nutritional quality and protein content, soybean is a raw material in a variety of food products and is used as an important feed material. Recently, soy foods and their bioactive compounds have received significant attention because of their human health benefits, and they are also known as the ‘functional foods of the century’ (Shea et al., 2020).

Soybean (*Glycine max* L. Merr.) belongs to the legume family Fabaceae and includes more than 40 species. Soy is an annual herbaceous plant with a height ranging from 25 to 200 cm. The human body's need for protein can mainly come from soybean meal as it contains up to 52% protein, 25% oil, and various vitamins. Soybean is a potentially important plant, ensuring the country's food security. Given the higher protein and oil contents in its seed, it is grown in 122 million ha in more than 20 countries worldwide (Kurbanbaev et al., 2023). Soybean's larger growing areas in various countries might be due to the nutritious qualities of its grain and green mass, which can serve as food, feed, technical, and medical fields (Bhartiya et al., 2012). Based on the soybean genotypes and environmental conditions, its grain oil and protein vary from 17% to 26% and 30% to 55%, respectively. The soybean grain also contains carbohydrates (20%–25%), macro and micro-elements including Ca, P, K, Na, Mo (4%–5%), and I and vitamins (E, B1, B2, B6) (Rasyad et al., 2018). Soybean is one of the main crops in the by-product of food protein, oil, cottonseed meal, and forages, with more than 1,000 products obtained (Kuswantoro et al., 2020)

It is already known that agriculture, the food industry, animal husbandry, and poultry farming are important economic sectors of the republic. According to the State Committee of the Republic of Uzbekistan dated 01 October 2022, statistics showed 35.8 million permanent residents in the republic. Therefore, the issue of providing the population with high-grade food urgently needs addressing. Based on this, enhancing the above principal agriculture economic sectors is a current issue requiring immediate action. In Uzbekistan, expanding the area under soybean and enhancing product outputs are vital for satisfying the population's requirements for oil products and consistently developing animal husbandry. Nowadays, developing the food industry, poultry, and livestock earnestly requires necessary measures to increase soybean production (Kholikhova and Matniyazova, 2023). Soybean is rich in protein and also has a large number of essential amino acids. Soybeans contain 14 times more protein than chicken, four times more than eggs,

and 3.5 times more than beef. In soybean oil, protein reaches 75%, called soy isolate, which is used in preparing various sausages (Yormatova, 2004).

The yield attributes of a soybean crop are ensured by the following indicators: the number of plants per unit area, the number of pods per plant, the number of grains per plant, the weight of 1000 grains, the number of pods per plant, the number of seeds per plant and seed yield (Idrisov, 2023). The number of pods per plant varies from 10 to 350 depending on the variety, soil, and climatic conditions (Lukov, 2022). The purpose of the study: Study of yield and yield contributing traits of foreign and domestic soybean varieties grown as repeat crops.

Material and methods

Plant material, experimental conditions and statistical analysis

The field experimentation transpired during 2020–2022, for yield-related traits, in the Samarkand and Navoi regions of Uzbekistan. The data were documented on ten plants selected at random from each entry of each replication for the number of pods per plant, the number of seeds per plant, 1000-seed weight and seed yield.

All 6 soybeans (Selekta-201 (control), Sparta, Nena, Oyjamol, Ustoz-Mman-60, and Tomaris-Mman-60) varieties in this study are given. All genotypes were of cultivated soybean (*Glycine max* L.) type, most genotypes originated from Russia, Kazakhstan and Uzbekistan ($n = 30$). The major elements established in the soil were nitrogen (0.098%), phosphorus (0.176%), potassium (0.58%), and humus (1.720%). The soybean cultivars, grown in a randomized complete block design, had a factorial arrangement with three replications. The data were scrutinized statistically using the analysis of variance of Fisher's technique and least significant difference (LSD) test at the 5% level of probability (Steel et al., 1984).

Results

Research work was carried out in the field conditions of the Pakhtachi district of the Samarkand region and the Karmana district of the Navoi region during 2020-2022. The local soybean varieties Ustoz-MMan-60, Tomaris-MMan-60, Oyjamol, and Selekta-201 belong to the selection of Uzbekistan and Nena belongs to the selection of foreign Russia, Sparta belongs to the selection of Kazakhstan. In 2020, in Samarkand and Navoi regions, it was noted that the number of pods per plant of local and foreign soybean varieties was higher compared to the control for all varieties. The highest values were determined for the local variety Ustoz-Mman-60 (125.8 ± 4.76 pieces) in the Samarkand region and for the foreign variety Sparta (130.7 ± 6.35 pieces) in the Navoi region. In the field conditions of Samarkand and Navoi regions, it was noted that the number of pods per plant for soybean varieties ranges from 70 to 100. In traits of the number of pods per bush in the Samarkand region, the varieties Tomaris-MMan-60 and Ustoz-MMan-60

are superior to the standard and other varieties in the experiment, and in the Navoi region, it was noted that the variety Sparta had more (Table 1).

In 2021, the number of pods per bush for soybean varieties was the highest in the Samarkand region for the local varieties Tomaris-MMan-60 and Ustoz-MMan-60 (115.1 ± 3.70 pcs. and 118.3 ± 6 , respectively (54 pcs.) and in the Navoi region for the Sparta variety - 106.5 ± 3.87 pcs., and low indicators in the field conditions of Samarkand and Navoi regions for the control variety (respectively 78.1 ± 3.83 pcs. and 73.6 ± 3.26 pcs.).

Table 1. Indicators of the number of pods per plant for soybean varieties sown as a repeat crop in the conditions of the Samarkand region, units

Local and foreign varieties of soybeans	2020	2021	2022
Selekta-201 (control)	73.9 ± 2.16	78.1 ± 3.83	99.2 ± 2.47
Sparta	87.1 ± 3.06	88.9 ± 7.42	110.5 ± 3.22
Nena	78.0 ± 2.44	89.1 ± 4.29	104.2 ± 1.69
Oyjamol	74.3 ± 2.46	89.4 ± 3.68	110.9 ± 4.01
Ustoz-Mman-60	125.8 ± 4.76	115.1 ± 3.7	209.1 ± 3.08
Tomaris-Mman-60	94.1 ± 4.26	118.3 ± 6.54	170 ± 3.42

In the Samarkand region, the number of pods per plant of domestic and foreign soybean varieties in 2022 is the highest for the Ustoz-MMan-60 variety in the Samarkand region (209.1 ± 3.08 pcs.) and for the Oyjamol variety in the Navoi region (277.2 ± 8.6 units), and the lowest indicator was found in the Selecta-201 variety (control) (99.2 ± 2.47 units) and in the Navoi region in the Nena variety (97.5 ± 8.21 units). In traits of the number of pods per plant, the local varieties Tomaris-MMan-60 and Ustoz-MMan-60 in the Samarkand region are superior to the experimental control and other varieties, and in the Navoi region - the varieties Sparta and Oyjamol. More than the control and other varieties, it was noted that it was more compared to the varieties. In the field conditions of Samarkand and Navoi regions, the foreign control variant Selekta-201 (control) and the Nena variety had a small number of pods per bush compared to other experimental varieties (Table 2).

Table 2. Indicators of the number of pods per plant for soybean varieties sown as a repeat crop in the conditions of the Navoi region, units

Local and foreign varieties of soybeans	2020	2021	2022
Selekta-201 (control)	69.8 ± 1.68	73.6 ± 3.26	100.6 ± 3.6
Sparta	130.7 ± 6.35	98.8 ± 7.38	214.0 ± 10.31
Nena	96.4 ± 2.9	94.5 ± 3.25	97.5 ± 8.21
Oyjamol	97.1 ± 4.96	106.5 ± 3.87	277.2 ± 8.6
Ustoz-Mman-60	85.6 ± 1.85	85 ± 5.76	110.9 ± 4.87
Tomaris-Mman-60	80.3 ± 3.5	75.6 ± 5.22	131.6 ± 2.41

The total number of grains per plant of domestic and foreign soybean varieties is sown as a repeat crop. In the first year of the experiment, for domestic and foreign soybean varieties planted in

the Samarkand region, the highest total number of grains per plant compared to the control was for the local variety Ustoz-MMan-60 (386.3 ± 6.25 pieces), and the lowest indicator was observed in the control variety (205.7 ± 8.47 units) (Table 3).

Table 3. Indicators of the total number of grains per plant for soybean varieties sown as a repeat crop in the conditions of the Samarkand region, grains

Local and foreign varieties of soybeans	2020	2021	2022
Selekta-201 (control)	205.7±8.47	220.5±5.47	290.2±6.97
Sparta	260.2±7.7	259.2±6.03	369.2±5.53
Nena	282.2±7.02	354.4±9.26	310.7±6.26
Oyjamol	213.3±10.79	269.3±7.43	350.0±5.93
Ustoz-MMAN-60	386.3±6.25	329.2±7.7	318.9±6.2
Tomaris-MMan-60	221.7±8.76	263.0±6.52	321.6±8.02

Among local and foreign soybean varieties planted in the Navoi region, the Ustoz-MMan-60 variety (389.9 ± 6.2 units) has the highest indicator of the total number of grains per plant compared to the Selekta-201 variety. (Table 4)

Table 4. Indicators of the total number of grains per plant for soybean varieties sown as a repeat crop in the conditions of the Navoi region, units

Local and foreign varieties of soybeans	2020	2021	2022
Selekta-201 (control)	201.2±7.47	214.9±8.47	298.4±5.97
Sparta	251.2±7.03	294.6±6.03	408.2±7.03
Nena	285.6±7.76	281.3±9.76	299.6±8.76
Oyjamol	288.4±8.93	420.0±5.93	424.6±8.93
Ustoz-MMAN-60	389.9±6.2	312.3±6.7	316.7±6.2
Tomaris-MMan-60	238.9±8.52	215.1±5.52	387.9±5.77

In 2021, the highest indicators were determined in the Samarkand region of foreign Nena (354.4 ± 9.26 units) and in the Navoi region for the Ustoz-MMan-60 variety (312.3 ± 6.7 units). All other varieties showed better results compared to the control variety. According to the results recorded in 2022, the highest indicators were found in the Oyjamol variety (420.0 ± 5.93 units and 424.6 ± 8.93 units, respectively) in the Samarkand and Navoi regions. In the course of our research, the total mass of grain per plant was studied as one of the most important yield attributes. In local and foreign soybean varieties of Samarkand and Navoi regions in 2020, compared to the control variant, the highest indicator was determined for the local variety Oyjamol (239.81 ± 1.16 g and 241.01 ± 1.16 g, respectively). The lowest indicator was determined in the Nena variety (61.79 ± 1.04 g and 62.95 ± 1.05 g, respectively) (Table 5).

Table 5. Indicators of the total weight of grain per plant of soybean varieties planted as a repeat crop in the conditions of the Samarkand region, grams.

Local and foreign varieties of soybeans	2020	2021	2022
Selekta-201 (control)	81.78±1.29	83.02±1.28	73.4±1.36
Sparta	110.15±1.28	111.39±1.27	118.14±0.88
Nena	61.79±1.04	62.95±1.05	67.53±0.62
Oyjamol	239.81±1.16	241.01±1.16	270.41±1.37
Ustoz-MMAN-60	83.61±0.51	84.92±0.5	93.63±2.09
Tomaris-MMan-60	115.26±1.25	116.5±1.23	124.01±3.08

When the indicators of grain weight per plant in local and foreign soybean varieties in Samarkand and Navoi regions were studied from 2020 to 2022, in Samarkand and Navoi regions Sparta, Oyjamol, and To'maris-MMAN-60 soybean varieties Nena, Ustoz-MMAN-60 and Selekta-201 (control) varieties were found to be higher. From 2020 to 2022, in soybean varieties in Samarkand and Navoi regions, the grain weight indicators per plant are mainly from 60 g to 95 g in Nena, Ustoz-MMAN-60, and Selekta-201 (control) varieties. , Sparta, Oyjamol and To'maris-MMAN-60 soybean varieties showed values higher than 100 g (Table 6).

Table 6. Indicators of the total weight of grain per plant of soybean varieties planted as a repeat crop in the conditions of the Navoi region, grams

Local and foreign varieties of soybeans	2020	2021	2022
Selekta-201 (control)	67.13±1.05	68.62±1.04	71.71±0.99
Sparta	99.74±0.8	101.19±0.83	120.76±0.85
Nena	63.07±0.85	64.55±0.86	69.86±0.92
Oyjamol	160.8±3.5	162.26±3.53	310±0.91
Ustoz-MMAN-60	82.94±1.78	84.37±1.77	92.43±1.1
Tomaris-MMan-60	109.12±0.51	110.64±0.59	126.66±2.01

In 2020, the highest weight of 1000 grains for local and foreign soybean varieties in the Samarkand and Navoi regions was 183.94 ± 4.04 g for the local variety Tomaris-MMan-60 in the Samarkand region and 184.02 ± 1.95 g for the Oyjamol variety in Navoi (Table 7). The lowest values were observed for the Selekta-201 variety (control) (162.56 ± 0.7 g and 162.34 ± 0.55 g, respectively). The remaining varieties showed higher performance compared to the control variant. In 2021, the highest indicators compared to the control were 185.17 ± 1.42 g in the Tomaris-MMan-60 variety in the Samarkand region and in the Sparta and Oyjamol varieties in the Navoi region (176.26 ± 2.07 g and 184.02 ± 1.95 g, respectively). In the field conditions of Samarkand and Navoi regions, the weight of 1000 grains of the remaining varieties turned out to be from 150 to 160 grams. It was found that the varieties Selekta-201 (control) and Nena have a lower weight of 1000 grains compared to other varieties in the experiment. In 2022, the Ustoz-

MMan-60 variety in the Samarkand region (205.28 ± 1.57 g) and the Sparta variety in the Navoi region (215.65 ± 3.00 g). The lowest values were noted for the Seleкта-201 (control) variety (180.74 ± 0.63 g and 174.56 ± 1.46 g, respectively).

Table 7. Indicators of the weight of 1000 grains of soybean varieties planted as a repeat crop in the conditions of Samarkand and Navoi regions, grams

Samarkand region			
Local and foreign varieties of soybeans	2020	2021	2022
Seleкта-201 (control)	162.56±0.7	156.6±0.8	180.74±0.63
Sparta	168.3±0.18	157.15±0.02	196.83±1.29
Nena	163.44±0.54	156.26±1.41	183.81±1.36
Oyjamol	173.1±0.71	159.26±2.04	183.02±1.66
Ustoz-MMAN-60	175.24±1.48	163.39±0.13	205.28±1.57
Tomaris-MMan-60	183.94±4.04	185.17±1.42	200.31±14.48
Navoi region			
Local and foreign varieties of soybeans	2020	2021	2022
Seleкта-201 (control)	162.34±0.55	157.24±0.85	174.56±1.46
Sparta	178.06±0.66	176.26±2.07	215.65±3.39
Nena	171.02±0.71	149.96±2.32	176.16±0.77
Oyjamol	184.02±1.95	175.66±1.44	197.31±1.42
Ustoz-MMAN-60	171.92±1.25	156.02±1	177.04±2.2
Tomaris-MMan-60	163.58±1.11	158.6±1.69	190.91±0.74

Discussion

The weight of 1000 seeds is of great importance in increasing the yield, germination, fertility, and oil content of soybean varieties created and created by breeders at present. Fertilization of such seeds is good and allows you to get a high yield. The more complete the seed, the more sufficient reserves of nutrients are created to fully provide its sprout with the necessary nutrients in the first stages of its development (Rakhimov et al, 2021; Matniyazova et al, 2023).

Grain size as a crop element has a significant impact on yield. The weight of 1000 grains also varies depending on environmental conditions and the agricultural technology used. Favorable temperature and diet allow the formation of large grains; on the contrary, hot and dry air, lack of moisture, weeds, pests, and diseases reduce the weight of 1000 grains (Kholikhova et al., 2020). In an experiment when studying the weight of 1000 grains of local and foreign soybean varieties in the Samarkand and Navoi regions in the period 2020-2022, the soybean varieties Sparta and Oyjamol in the Navoi region were higher compared to Seleкта-201 variety and other genotypes. In the Samarkand region, higher indicators of the Ustoz-MMan-60 and Tomaris-MMan-60 varieties were revealed compared to the control variety Seleкта-201 (control) and other genotypes. Indicators of the number of grains per plant for domestic and foreign soybean varieties in the Samarkand and Navoi regions for 2020-2022 Soybean varieties Nena, Ustoz-MMan-60,

Oyzhamol, and Tomaris-MMan-60 for the Samarkand region, for the Navoi region Ustoz-MMan-60, Nena, Sparta and Oyjamol had higher rates compared to the control variety.

Conclusion

When the yield and yield attributes of local and foreign soybean varieties in the Samarkand and Navoi regions were studied, local Ustoz-MMan-60 and Tomaris-MMan-60 soybean varieties showed positive results compared to other varieties for the field conditions of the Samarkand region, while Navoi For the field conditions of the region, Sparta and Oyjamol varieties showed higher indicators compared to other varieties. In the experiment, it was found that some foreign soybean varieties are positive in yield traits of productivity in the region of Uzbekistan.

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