Studying the Influence of Sowing Time on the Chemical Composition of Soybean Plants in the Southern Regions of Uzbekistan

Yormatova Dilarom Yormatovna
Doctor of Agricultural Sciences, Professor, Uzbekistan State World Languages University, Tashkent, Uzbekistan, soya-oliva@mail.ru

Khamroyeva Marguba Komilovna
Candidate of Biological Sciences, Associate Professor, Denov Institute of Entrepreneurship and Pedagogy, Denov, Uzbekistan, marguba2184@mail.ru

Lukov Mamadali Qudratovich
Candidate of Science in Agriculture, Termez State Institute of Agriculture and Agrotechnologies

Mallaev Muslim Khushnazarovich
Researcher, Denov Institute for Entrepreneurship and Pedagogy, Denov, Uzbekistan Ferghana State University, Republic of Uzbekistan

Abstract

Soy is important, protein, technical legume. In recent years, in our country, the interest of producers and farmers in growing this crop has increased, as evidenced by the annual increase in sown areas from 100 hectares to 300 thousand hectares. Currently, soybeans are sown as the main and secondary crop after winter wheat. Seeds are imported from other countries; these varieties are introduced in our dry and hot climate.

The purpose of our research is to study the effect of sowing time on the chemical composition of seeds and yield, as well as the adaptation of varieties of Russian selection in the dry and hot climate of Uzbekistan. Varieties of the Russian selection “Slavia” and “Chara” and local varieties “Madaniyat “B”, “Madad” and “Orzu” were studied. The studied varieties in the south of Uzbekistan are superior in yield and quality indicators.

Keywords: *soybean variety; oil; protein; introduction; sowing dates; harvest; grains; beans; branches; leaves.*

INTRODUCTION

Soy is an important, protein technical legume. In recent years, in our country, the interest of producers and farmers in growing this crop has increased, as evidenced by the annual increase in soybean sown areas from 100 hectares to 300 thousand hectares. Currently, soybeans are sown as the main and secondary crop after winter wheat. Seeds are imported from other countries; these varieties are introduced in our dry and hot climate.

The peculiarity of Uzbekistan in terms of climate and soil fertility differs sharply from other regions. Spring comes here earlier and soybeans are sown in the shortest possible time, unlike in Krasnodar and the Far East. This made it possible to analyze the change in the chemical composition of soybeans in connection with contrasting climatic conditions. The timing of sowing and the elements of soybean agrotechnology affect the assimilation processes and the chemical composition. Of all agrotechnical practices, the most significant influence on the development of soybean varieties is provided by optimal sowing dates, according to soybean scientists (24, p. 9042-9046; 3, p.106-109; 6, p. 30-31).

In Uzbekistan in 2017, in connection with the adoption of new laws on the cultivation of soybeans and the commissioning of new soy processing enterprises, the demand for soy grain increased. Soybean in Uzbekistan is a new introduced crop, it is necessary to increase soybean production primarily through the use of new more highly productive varieties. The potential productivity of a variety can be realized only when creating optimal growing conditions, taking into account its sowing time and biological characteristics.

The second important factor determining the quality of the soybean crop is the temperature regime and air humidity, these factors in our conditions are mitigated by the presence of artificial irrigation, but even so, changes in the chemical composition of seeds can be expected. The chemical composition of soybean seeds depends on a whole range of factors, however, it fluctuates in insignificant redistributions, since the main factor determining the chemical composition of seeds is the biological characteristics of the variety.

METHODS

To identify the complex effect of the biological characteristics of soybean varieties that differ in early maturity, experiments were carried out on meadow-serozem soils (Denov district, Surkhandarya region). A comparison of two contrasting sowing dates, spring 1/IV and summer 15/VI, showed that at these dates the chemical composition of soybean seeds changes rather slightly (Table 2). The average protein content in soybean seeds during spring sowing also, regardless of the precocity group, decreases by 0.9 ... 3% compared to summer sowing. At the same time, it should be noted that mid-season varieties during spring and summer sowings, compared with early and late-ripening varieties, contained more oil and protein (2, p. 39-42).

RESULTS

The analyzes showed that in different varieties of soybeans, the yield and protein content vary depending on the timing of sowing. With late sowing of seeds, the protein content is higher, with early sowing of seeds, the oil yield is greater. For example, in the Madaniyat "B" variety, with early sowing, the protein in the seeds varies from 39.2 to 40.7%, the oil content varies from 19.7 to 21.0%. In the Madad variety, the protein content is from 38.4 to 40.2%, the oil content ranges from 19.2 to 21.45.

As a result of the research, we came to the conclusion that the most important element of soybean agrotechnology in specific soil and climatic conditions of the southern regions of Uzbekistan is the sowing time. Since 2018, soybean sown areas in Uzbekistan have been increasing, so it is necessary to determine specific sowing dates for these varieties. For study, we took zoned varieties of Uzbek and Krasnodar selection.

The study of soybean varieties of Krasnodar breeding showed that the seeds of the Slavia variety contain more oil, but the grain yield

was two times lower compared to domestic varieties. The Chara variety is early maturing, undersized, forms 34-52 beans, low-yielding in the conditions of Uzbekistan.

The growing season of the studied soybean varieties is 90–110 days from germination to maturation. Krasnodar varieties showed high adaptive abilities to dry and hot conditions of Surkhandarya. The height of the Krasnodar varieties ranged from 70–95 cm, with a compressed bush form, forming 1–3 branches, 8–11 nodes in the upper part of the stem. The variety Slavia and Olympia had a sub cotyledon of violet color, pointed leaves, pubescent stem and leaves, the color of the beans was light brown (reddish). Inflorescence - many-flowered (4-8 flowers) brush, but forms 3-5 beans; flowers with a purple corolla. Seeds are elongated-oval, with a yellow skin and a brown scar. The weight of 1000 seeds is 160-180 g, but in the conditions of Uzbekistan the weight of 1000 seeds is 133-140 g. The protein content varied from 35–40%, while the oil content varied from 17–20%.

Soils of the experimental plot of serozem of old irrigation, with a humus content of 0.9-1.1%, mobile phosphorus 22.3 mg / kg, nitrogen 17.4%, potassium 245.0 fertilizers.

Table 1. The content of NPK in the soil of the experimental plot before sowing in a mobile form, mg/kg of soil

Horizon, cm	Humus, %	Nitrate N-NO_3	Phosphorus P_2O_5	Potassium K_2O
1st section				
0-25	1,008	16,3	22,0	245,0
25-35	0,986	8,1	13,4	224,0
35-45	0,627	6,8	9,2	204,4
2nd section				
0-25	1,003	17,4	23,3	243,0
25-35	783.1	8,5	12,8	229,7
35-45	597,3	6,3	9,8	201,4

Humus in a layer of 0-25 cm at site No. 1 contains 1.008%, and at site No. 2 humus is 1.003%. In the lower layers of the soil, the humus content decreases by 0.627%, in plots No. 2, the percentage of humus is 0.597%. The content of mobile nitrate in the soil at a depth of 0-25cm is 16.3 mg/kg of soil in the first plot, and 17.4 mg/kg of soil in the second plot. In the lower soil layer, the amount of mobile nitrate decreases to 6.3 mg/kg of soil. Phosphorus in the soil of experimental plot No. 1 in the 0-25 cm layer was 22.0 mg/kg, and in the 25-35 cm layer in the first plot 13.4 mg/kg of soil. And in the second section of the experimental field - 8.5 mg / kg of soil. As the data obtained show, in the lower soil layer, the amount of all nutrients is less. The soil of the experimental field is not very fertile and requires the application of mineral fertilizers and agrotechnical measures.

The climatic conditions of Surkhandarya make it possible to obtain two crops of soybeans. The duration of the frost-free period here reaches up to 280 days. Average daily temperatures are above 10 0C in all regions of the region, warm weather sets in here in the

second half of March. Thus, the period of possible germination of soybean varieties is from the beginning of April to the end of October. The absolute maximum in summer reaches 23.5-46.9 °C, in winter the absolute minimum temperature drops to minus 20-23 °C in the southern regions of the region, an insignificant amount of precipitation falls - 130-160 mm per year; relative air humidity in summer is very low, in some months it drops to 18-20%. The duration of the frost-free period is 226-227 days in Denov and Kumkurgan, 234 days in Termez and 266 days in Sherabad. The first autumn frosts come on November 2-24 (in Termez and Sherabad), in Termez the last spring frosts end on March 2-12. The sum of effective temperatures at the lower limit of 10°C in Termez is 3306°C, which is higher than at any point located in other regions. Due to the low rainfall during the growing season, soybean varieties are grown here only on irrigation. Therefore, the need to develop agrotechnics for stubble crops for soybean varieties is increasing, this method of sowing is economically profitable, you can get two crops per year from 1 hectare. Table 2 shows that the average fat content for all groups of precocity of varieties during spring sowing is lower by 2 ... 3% compared to summer sowing.

Table 2. Influence of sowing dates on the content of oil and protein in soybean seeds on gray soils (2020-2021).

Varieties	Oil content, %		Oil yield kg/ha		Protein content, %		Protein yield kg/ha	
	Spring sowing	Summer sowing	Spring sowing	Summer sowing	Spring sowing	Summer sowing	Spring sowing	Summer sowing
Early maturing								
Orzu	16	18	256	240	36	38	524	528
Slavia	18	19	275	251	39	42	566	550
Chara	16	17	289	244	36	39	663	631
Olimpiya	18	19	270	260	34	38	532	541
Average	17	19	289	267	37	40	597	581
Mid-season								
Madad	20	22	396	362	40	42	689	675
Madaniyat «B»	19	21	399	381	36	39	756	744
Orzu	20	22	400	381	37	39	740	705
Average	20	21	400	374	38	40	740	712

To study the effect of soybean sowing time on crop quality in 2021-2022. experiments were carried out with five varieties that differ in early maturity in Surkhandarya region. Soybean was sown starting from March 25 with an interval of 10 days. Previously developed agricultural technology was adopted. 90 kg of ammophos and 60 kg of nitrogen were introduced. Five watering and three cultivations. The experiment was carried out in fields where soybean had not previously grown and nodule bacteria were absent (21, p. 243-245; 22, p. 4-5; 26, p. 57-58; 27, 230 p.).

As a result of two-year observations, it was found that early sowing dates by 1.2 ... 2.5% reduce the content of crude fat in the seeds of all varieties, regardless of early maturity and origin, but the largest reduction in fat by 2.5% was noted in the Madaniyat “B” variety. The content of crude protein during sowing at a later date increased by 2.7...7.2% (Table 2).

DISCUSSIONS

Experimental data obtained in the experiments show that there is a certain relationship between the timing of sowing soybeans of different ripening varieties and quality indicators (protein and oil content in seeds). The quantitative proportions of changes in these indicators depending on the timing of sowing varieties Slavia and Madaniyat "B" and Orzu were revealed. Pair correlation coefficients for variety Slavia were ch1.2 = 0.70 and 0.73.

Table 3. Effect of sowing time on the content of fat and protein in soybean seeds, %. (2020-2021)

Sort	Indicators	Sowing term				
		20 111	51.IY	110.IY	320.IY	130.IY
Madaniyat «B»	protein	37,3	37,7	37,8	38,5	40,5
	fat	21,8	20,9	20,0	18,3	20,5
Slavia	protein	36,5	36,8	37,3	38,4	39,4
	fat	22,3	21,6	20,9	21,1	19,3
Chara	protein	35,3	36,9	37,8	38,9	39,4
	fat	21,8	21,6	20,5	20,3	21,4
Madad	protein	34,2	36,4	37,5	38,3	39,0
	fat	21,3	20,4	20,3	18,0	19,3
Orzu	protein	34,9	36,8	38,5	37,3	39,3
	fat	22,3	21,6	20,3	20,5	21,4

According to the results of the chemical composition of seeds of soybean varieties, that, with late sowing on Madaniyat "B" sort, a decrease in oil content by 1.3%, and an increase in protein content is observed by 3.2 percent. In the Slavia variety, at early sowing, the protein content is 36%, and at late sowing 39.4%, the oil percentage at early sowing is 22.3 and at late sowing it is 19.3 percent. The study showed that other varieties also had identical performance.

Pair determination coefficients h1,2 = 0.049 and h2,2 = 0.533 show that 49.0% and 53.3% of variations in oil and protein content in beans can be explained by changes in sowing time [2].

The reliability criteria for the tightness of the connection in both cases are M1 = 7.4 and M2 = 8.7, which is much higher than the maximum allowable - 2.8.

For the Madad variety, h3.4 = 0.63 and 0.66. Pair determination coefficients ch3.2 = 0.397 and ch4.2 = 0.436 by 39.7% and 43.6% explain variations in soybean quality from sowing time. Reliability criteria for the closeness of communication M3 = 8.5 and M4 = 8.7 with a very acceptable value of 2.8.

For variety Madaniyat "B" - 1 h5 = 0.71 and h6 = 0.69

Pair determination coefficients ch5.2 = 0.504 and ch6.2 = 0.467 by 50.4% and 47.6% explain the variations in the quality of this soybean variety from sowing dates. The reliability criteria for the tightness of the connection are quite large and amount to M5 - 8.9 and 8.8, respectively, with the maximum allowable value (4, p.351).

After harvesting winter crops, Surkhandarya region has sufficient natural resources of land, light, heat, moisture and soil fertility to obtain consistently high yields of soybeans.

Determining the leaf area is also of independent importance in determining the leaf index and photosynthetic potential.

When using the formula, it is assumed that the leaf surface grows evenly during the observation period.

In fact, in most cases, the leaf area increases unevenly.

In this regard, foreign researchers have proposed a different formula for determining the net productivity of photosynthesis (5, p. 32-33; 28, p. 49-50; 29, p. 89-101; 31, p. 1074-1078).

According to research materials of scientists, the optimal choice of sowing dates for soybean varieties is not only an increase in soybean grain yield, but also obtaining seeds with high chemical qualities, which was noted in the works (Myakushko Yu.P., 1983, 318 p.; Zhadanov N., 1982, pp. 86-88; Dvoryadkin, 1983, pp. 32-33; I.I. Chaly, 1984, pp. 37-39; Karyagin Y.G. 1996, pp. 28-29; Zaveryukhin V.I. 1990, pp. 16-17; Zubritsky, V.A. 1992, pp. 25-26; Agaev M.G., 1993, pp. 6-9; Zelentsov S.V., 1995, p. 22; Klyushin P.V. 1998, 116 p.; Dozorov A.V. 1999, pp. 30-31; Dozorova T. 2000, pp. 57-58; Baranov V.F. et al., 2004, p. 39 -40; Oborskaya Yu.V., Kamanina L.A. 2010, pp. 46-47; Baranov V.F., Baranova L.A., 2011, pp. 106-109). In 2020-2021, we conducted a series of experiments on the reaction of an early-ripening soybean variety to the chemical composition of the grain.

Analyzing the results presented in Table 3, we can say that the leaf area of the Madaniyat "B" variety at the beginning of flowering ranged from 5.42 in the first sowing period, and in the third sowing period in this phase to 8.10 thousand m2 / ha, and during summer sowing, in the flowering phase, the leaf area was 8.96 thousand m2 / ha.

The largest size of the assimilation apparatus in the Madaniyat "B" variety at the first and third sowing dates fell on the phase of bobo formation.

Based on the materials of Ugo Toro Correa (19) he obtains the same data for the variety Lira, the maximum leaf area of 26 thousand m2/ha is observed in the phase of bobo formation [3, pp. 106-109; 30, pp. 843-849]. According to Zelentsov S.V. (11, pp. 40-58; 25, pp.67-72), the soybean varieties closest to the average long-term values in terms of heat supply was 2012. In 2013, the sum of active temperatures exceeded the norm by 164 °C, and the average daily air temperatures in the summer months were uniform or close: from 16.1 in August to 17.5 °C in June.

The yield of soybean varieties by sowing time varied. The obtained materials show that with late sowing, soybean varieties produce few beans, with a decrease in the number of beans, regardless of precocity, the yield of soybean varieties decreases.

The data obtained show that soybean varieties with early and late sowing formed few beans, as a result, the grain yield for the Orzu variety is higher compared to other varieties, which are 26.5 centners per hectare in spring sowing, and 22.0 centners in summer sowing for one hectare.

Table 4. Influence of sowing dates on the number of beans and the yield of soybean varieties, pcs, centner/ha (2020-2021)

Sort	Indicators	Sowing term				
		20.IY	1.IY	10.IY	30.IY	15.IY
Madaniyat-«B»	Number of beans	54,3	56,7	57,8	58,5	51,5
	harvest	22,8	24,9	28,3	25,8	24,7
Slavia	Number of beans	31,2	34,1	38,5	36,6	35,5

	harvest	17,3	19,6	21,3	17,1	18,9
Chara	Number of beans	30,1	32,6	34,7	33,2	32,4
	harvest	16,0	17,9	19,8	18,9	17,1
Madad	Number of beans	44,7	46,4	47,5	42,3	44,0
	harvest	22,5	22,5	23,5	20,3	19,5
Orzu	Number of beans	44,6	46,7	48,7	43,2	37,9
	harvest	25,4	24,9	26,5	22,0	21,6

Analyzing the data on the structure of the crop, it is clearly seen that with early sowing, the soil is not yet warm enough and low temperatures are observed, all these negative factors affect the germination of soybean seeds.

Studying the data on the structure of the crop, it can be seen that the soybean varieties of the Krasnodar and Uzbek breeding are different in terms of morphological and generative indicators. In addition, according to the sowing time, the height of the plants varies, depending on the varietal characteristics.

And also, with early sowing in all varieties, an increase in the height of attachment of the lower beans, the number of beans, the total number of seeds per plant is observed. The data in the table show that the yield structure of all varieties was different.

Table 5. Yield structure of Slavia soybean depending on sowing time

Sowing dates	Height, cm		Quantity, pcs. rast			Seed weight, g	
	plants	Attached bean	branches	beans	seeds	1s 1st growth	1000 PCS
20.03.2021	90,1	9,8	2,1	38,3	88,0	8,9	138
1.04.2021	93,6	8,8	2,3	43,7	92,2	10,7	141
10.04.2021	86,3	8,1	2,0	36,1	82,5	9,4	139
20.04.2021	81,0	7,5	2,0	33,7	76,1	8,7	137
30.04.2021	76,5	7,1	1,6	31,0	73,8	7,8	136

The study of the sowing dates of different soybean varieties showed that with early sowing, the height of the Slavia variety was higher, when sowing on March 20, the height of the plants was 90.1 cm, and when sowing on April 1, it was 93.6 cm. late sowing. The yield, the number of branches, beans and seeds of one plant decreased at a late sowing date. The mass of seeds is greater when sown on April 1, which is 10.7 grams per plant. At the latest sowing, the seed weight of one plant was 7.8 g.

Table 6. Yield structure of soybean variety Madaniyat "B" depending on the timing of sowing

Sowing dates	Height, cm		Quantity, pcs. rast			Seed weight, g	
	plants	Attached bean	branches	beans	seeds	1s 1st growth	1000 PCS
20.03.2021	117,2	13,2	3,1	56,2	121,8	13,6	139
1.04.2021	122,4	14,7	3,6	62,6	134,2	14,7	143
10.04.2021	123,6	14,6	3,5	63,1	133,6	14,2	141
20.04.2021	119,8	12,7	3,2	56,2	127,0	12,8	139
30.04.2021	117,3	11,0	3,0	55,3	123,8	12,2	137

Variety Madaniyat “B”, refers to the Uzbek selection. Observation of the growth and yield structure shows that the variety grows and develops safely, and gives a high yield, in the dry hot climate of Surkhandarya region with a long growing season. When sown on April 30, the height of plants and the number of branches and pods was less. The weight of 1000 seeds vary from 137 to 143 grams. A similar trend is observed in the height of attachment of the lower bean for both varieties, the same result was obtained.

Table 7. Influence of sowing dates on the yield of soybean varieties c/ha (2020-2021)

Sowing dates	Madaniyat B	Slavia	Chara	Madad	Orzu
20.03.2021	27,8	22,1	23,8	26,9	24,7
1.04.2021	34,7	24,6	25,7	32,7	32,0
10.04.2021	32,8	24,2	24,8	32,3	33,4
20.04.2021	31,9	22,7	23,6	28,5	27,6
30.04.2021	30,2	21,0	23,0	26,3	26,8
Average in terms	31,48	22,92	24,18	29,34	28,90

It can be seen from the tables that the Madaniyat “B” variety turned out to be the most productive in terms of sowing time, the average yield of the variety in terms of terms is 31.48 c/ha. The yield of Madad and Orzu varieties turned out to be almost the same, being 29, 34 and 28.90 centners per hectare. The Slavia variety turned out to be the lowest yielding, 22.92 c/ha of grain per hectare in a dry hot climate. This variety accelerated the growing season in our conditions by 20-22 days. The Chara variety has shortened its growing season by 18-16 days. These varieties received the sum of effective temperatures to grow and develop faster under our conditions and eventually mature earlier.

CONCLUSION

The best options for the timing of sowing and plant variety placement on farm plots have been identified, which contribute to the production of soybean seeds with high chemical qualities. An economic justification for the effectiveness of the sowing period was given, and the most productive soybean varieties were selected in the conditions of Surkhandarya region when grown for grain.

In general, the data obtained show that the soybean varieties Slavia and Chara in the dry and hot climate of Uzbekistan, along with the

local varieties Madaniyat “B”, Madad and Orzu, are distinguished by drought tolerance.

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