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**AGROTECHNOLOGICAL PECULIARITIES
OF SOYBEAN CULTIVATION IN THE IRRIGATED ZONE
OF SOUTH AND THE SOUTHEAST KAZAKHSTAN**

Abstract. The technology of cultivating Lastochka, highly productive variety of soybean, was compared with the furrowing irrigation with dripping irrigation based on renewable water energy and three different seeding rates.

The high yield of soybean variety Lastochka was 54.6 c/ha with the dripping irrigation under Ili Alatau, and 51.6 c/ha with an optimal 400 thousand pcs/ha seeding rate under the conditions of the Kyrgyz Alatau.

Keywords: irrigated agriculture, drip (trickle) irrigation, soybean, seeding rate, sowing technology, crop capacity.

Introduction. Soybean is an economically profitable crop which is produced without nitrogen fertilizers. It does not require the cost of compensation for damage to the environment and contributes to its preservation [1]. Also, it is in steady demand in the world market. Soybean production is profitable in all parts of the country. Profitability of production reaches up to 200%. Man cultivation of soybeans contributed to the detailed development of agricultural methods of its cultivation. The work of many farmer generations and national breeders turned this plant into a culture, which is well adapted to the mechanization of all cultivation technological processes, from planting to harvesting [2].

Soybean plants are subject to a number of abiotic and biotic stresses that affect to their growth and development. In particular, water deficiency is the main global abiotic factor affecting the productivity of all crops, particularly soybean [3]. According to the data of many authors, soil moisture, which is close to the lowest water capacity, has the highest tolerance for plants. As noted by many researchers, moisture is one of the main and irreplaceable factors of plant life [4]. Drip irrigation is one of the methods of irrigation, in which water in small portions is supplied evenly to the roots of the plant throughout the growing season and irrigation moisture is supplied only to the plants, and is not consumed in the row spacing [5]. Taking into account the potential of soybean productivity, water combinations and soil food regimes were determined, which ensure the formation of a yield of 3-4 t/ha of seeds. For this range of productivity, the regularity of the soybean formation evapotranspiration, the main parameters of drip irrigation regimes, the numerical values of the specific water consumption per unit of marketable products established the regularity of the yield formation of soybean seeds depending on the irrigation regime, the level of mineral nutrition and tillage [6].

Materials. The experience was laid in 2 areas of irrigated agriculture of the south and south-east Kazakhstan in 2016-2018. The piedmont irrigated zone of the Kyrgyz Alatau (farm “Nurzhan”, district Merken, Zhambyl region) on gray soils and the piedmont irrigated zone of Ili Alatau (demonstration site of the Kazakh Research Institute of Agriculture and Plant Growing) on bright chestnut soils;

The soybean variety Lastochka, which belongs to the group of medium late (III group of ripeness), was studied and it was approved for the use in Almaty, Zhambyl and South Kazakhstan regions.

The following measures were taken to prepare the soil for sowing soybean: dump plowing to a depth of 25-27 cm and pre-sowing treatment to a depth of 12-15 cm.

Direct sowing was done using a combination seeder Vence Tudo (Brazil), two-sided seeding method 50x20 cm, 3 seeding rates (400 thousand pcs/ha, 500 thousand pcs/ha, 600 thousand pcs/ha), 2 irrigation methods (dripping and furrowing).

Results. The definition and assessment of the density of the foothill bright chestnut irrigated soil of the Ili Alatau from the beginning of sowing and before the soybean harvest revealed that the indicators of the bulk weight of 0-30 cm layer with dripping irrigation were less than with furrowing.

The volume mass of the dripping irrigation increased by 0.03 g/cm³ During the growing season, while during furrow irrigation it increased from 1.21 g/cm³ from the beginning of the growing season to 1.32 g/cm³ by the end of the growing season, i.e. 11 g/cm³ (figure, table 1).



The study of soil density in two zones of irrigated agriculture

Table 1 – The change in the density of the foothill bright chestnut irrigated soil of the Ili Alatau (station of KazRIAPG) and the Kyrgyz Alatau (station of farm “Nurzhan”) depending on plowing and irrigation methods, g/cm³ (average 2016-2018 years)

Ways of irrigation	The beginning of the growing season		Middle of the growing season		Before harvesting culture	
	layer, cm	bulk weight	layer, cm	bulk weight	layer, cm	bulk weight
The Ili Alatau (station of KazRIAPG)						
Drip watering	0-10	1,16	0-10	1,17	0-10	1,19
	10-20	1,20	10-20	1,22	10-20	1,25
	20-30	1,27	20-30	1,27	20-30	1,28
	0-30	1,21	0-30	1,22	0-30	1,24
Furrow watering	0-10	1,15	0-10	1,21	0-10	1,28
	10-20	1,22	10-20	1,28	10-20	1,32
	20-30	1,26	20-30	1,32	20-30	1,36
	0-30	1,21	0-30	1,27	0-30	1,32
The Kyrgyz Alatau (station of farm “Nurzhan”)						
Drip watering	0-10	1,14	0-10	1,16	0-10	1,19
	10-20	1,20	10-20	1,23	10-20	1,25
	20-30	1,26	20-30	1,27	20-30	1,28
	0-30	1,20	0-30	1,22	0-30	1,24
Furrow watering	0-10	1,13	0-10	1,21	0-10	1,25
	10-20	1,21	10-20	1,27	10-20	1,31
	20-30	1,26	20-30	1,30	20-30	1,34
	0-30	1,20	0-30	1,26	0-30	1,30

A slight increase in the density of 0–30 cm of the soil layer was also observed with dripping irrigation from the beginning of the soybean vegetation period and before harvesting as compared with furrowing irrigation on the piedmont bright chestnut irrigated soil of the Kyrgyz Alatau.

Thus, the studies conducted in the foothill bright-chestnut irrigated soils of the Ili and Kyrgyz Alatau showed that dripping irrigation provided the creation of an optimal density of 0-30 cm layer, whereas in the furrowing irrigation its size went beyond the optimal indicators by the end of the growing season.

The elements of productivity are the main indicators of the biological yield of plants. Their formation depends on both genetic characteristics and external growth parameters. Irrigation methods had an impact on all signs of productivity, starting from the height of the plant and ending with the mass of seeds from the plant (table 2).

Table 2 – Comparative assessment of the productivity elements of soybean variety Lastochka, depending on the seeding rate and irrigation method

Ways of irrigation	Seeding rate thousand pcs/ha	Height, cm	Attachment height of lower beans, cm	Seed weight per plant, g	Weight 1000 seeds, g
Kyrgyz Alatau “Nurzhan” farm					
Drip watering	400	90,5	8,0	23,0	163,5
	500	90,2	7,8	19,5	165,4
	600	100,3	7,4	20,5	165,8
Furrow watering	400	85,4	5,6	21,6	163,2
	500	90,3	10,6	19,7	167,8
	600	105,6	9,5	15,4	165,4
Ili Alatau station (KazRIAPG)					
Drip watering	400	90,5	12,2	28,0	164,5
	500	95,2	12,8	24,5	166,4
	600	105,3	12,4	25,5	166,8
Furrow watering	400	90,4	10,6	26,6	164,2
	500	95,3	13,6	24,7	168,8
	600	110,6	14,5	20,4	166,4

The height of the plants in the Kyrgyz Alatau of the variety Lastochka was formed depending on the seeding rate and irrigation method in the range from 85.4 to 105.6 on dripping irrigation; moreover, the highest indicator was formed in thickened sowing at a seeding rate of 600 thousand pcs/ha. The height was higher under the conditions of the Ili Alatau. It was within 90.4-110.6 cm depending on the experience. The increased competition in the thickened sowing led to the stretching of the plants and their subsequent lodging. The height of the plants was 85-95 cm in sparse crops with a seeding rate of 500 and 400 thousand plants/ha.

The height of the lower bean sticking plays a major role for plants in the mechanized soybean harvest. the height of the lower bean sticking was within 7.4 -10.6 cm under the conditions of the Kyrgyz Alatau. It was 10.6 to 14.5 cm under the conditions of the Ili Alatau. The high indicators of this feature were characteristic of thickened crops as well as the height of the plant.

Seed productivity is determined by the mass of seeds per plant, so this indicator is the most important economically valuable attribute of all crops. According to N. Korsakov, the number of beans per plant is also a relative indicator when characterizing its productivity. It is used within samples with the same size of seeds, since the mass of 1000 seeds and the number of seeds in a bean has a wide range of variation. Therefore, in all other cases, an indicator of seed mass per plant is used determining the productivity of a plant. The variety Lastochka has a seed mass from a plant with dripping irrigation ranging from 19.5 to 23.0 g; with furrowing irrigation from 15.4 to 21.6 g under the conditions of the Kirghiz Alatau. The mass of seeds from one plant ranges from 24.5 to 28.0 g with dripping irrigation, and with furrowing irrigation from 20.0 to 26.6 g under the conditions of the Ili Alatau. The highest indicators of seed mass from a plant were formed at a seeding rate of 400 thousand seeds/ha with dripping irrigation.

The variety Lastochka is a medium seed with a mass of 1000 seeds 155-165 g by seed size. Different types of irrigation and seeding rates do not reveal significant differences on this basis. Sufficient moisture supply leads to the formation of a complete seed loading and to the formation of a genetically programmed trait.

Productivity is the main indicator for assessing the effect of an external trait on a plant. The yield was in the range of 45.2 to 51.6 c/ha with dripping irrigation depending on the seeding rate under the conditions of the Kyrgyz Alatau and it was 48.2 to 54.6 c/ha under the conditions of the Ili Alatau. Moreover, the highest yield was obtained at a seeding rate of 400 thousand seeds/ha (51.6 and 54.6 c/ha).

The yield was in the range of 38.6 to 43.6 c/ha with furrowing irrigation depending on the seeding rate under Kyrgyz Alatau conditions, and it was from 42.3 to 46.6 c/ha under the conditions of the Ili Alatau. A variant with a seeding rate of 400 thousand seeds/ha (table 3) was characterized by high yield with this method of irrigation.

Table 3 – Comparative assessment of the soybean variety yield Lastochka, depending on the seeding rate and irrigation method

Ways of irrigation	Seeding rate thousand pcs/ha	Kyrgyz Alatau yield t/ha	Ili Alatau yield t/ha
Drip watering	400	51,6	54,6
	500	48,6	51,6
	600	45,2	48,2
Furrow watering	400	43,6	46,6
	500	39,3	42,3
	600	38,6	43,6

Conclusion. Drip irrigation, compared to furrow irrigation, is a positive effect on the signs of productivity and ultimately on the yield by a water-saving irrigation method due to the even supply of water to the roots of plants. Intra varietal competition occurs in the thickened crops with a seeding rate of 600 thousand plants/ha, thus plants are stretched and become prone to lodging, fewer beans are formed on them and, as a result, the yield is reduced. Optimal conditions are formed to achieve maximum yield with sparse sowing with a seeding rate of 400 thousand plants/ha.

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ҚАЗАҚСТАННЫҢ ОҢТҮСТІК ЖӘНЕ ОҢТҮСТІК-ШЫҒЫСЫНДА СУАРМАЛЫ АЙМАҚТА МАЙ БҰРШАҚТЫҢ ӨСІРУДІҢ АГРОТЕХНОЛОГИЯЛЫҚ ЕРЕКШЕЛІКТЕРІ

Аннотация. Қазақстанның оңтүстігі мен оңтүстік-шығысындағы агроэкологиялық екі аймақта қарықпен суарумен салыстырғанда жаңартылатын су энергиясы негізінде тамшылатып суару кезінде май бұршақ дақылының Ласточка сортты өнімімен өсіру және агротехнологиясын және үш түрлі әдіспен себу нормалары зерттелінді. Іле жағдайында тамшылатып суаруда Ласточка сортының жоғары өнімділігі 54,6 ц/га, Қырғыз Алатауы жағдайында 51,6 ц / га құрады.

Түйін сөздер: суармалы егіншілік, тамшылатып суару, май бұршақ, себу нормасы, себу технологиясы, өнімділік.

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АГРОТЕХНОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ВОЗДЕЛЫВАНИЯ СОИ В ОРОШАЕМОЙ ЗОНЕ НА ЮГЕ И ЮГО-ВОСТОКЕ КАЗАХСТАНА

Аннотация. В двух агроэкологических зонах юга и юго-востока Казахстана изучена технология возделывания сои высокопродуктивного сорта Ласточка при капельном орошении на основе возобновляемой энергии воды сравнении с бороздковым поливом и 3 различные нормы высева. Установлены высокая урожайность сои сорта Ласточка на капельном орошении в условиях Илийского составила 54,6 ц/га, в условиях Киргизкого Алатау - 51,6 ц/га при оптимальной норме высева 400 тыс.шт/га.

Ключевые слова: орошаемое земледелие, капельное орошение, соя, норма высева, технология посева, урожайность.

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