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METHODS OF SUNFLOWER CULTIVATION IN THE DRY STEPPE ZONE

Abstract

An important reserve for increasing the yield of sunflower, along with the introduction of new highly productive varieties and hybrids, is the improvement of agrotechnical methods; the choice of the most optimal sowing dates is especially important. With adaptive cultivation technology, sowing sunflower in optimal terms is one of the most important conditions that determine obtaining of timely, harmonious and full shoots and the further good development of plants. The research aim is to study elements of adaptive technologies for sunflower cultivation to provide vegetable oil producers with high-quality raw materials. As a result of the research, data were obtained on the study of the elements of adaptive technologies for sunflower cultivation, namely, the sowing time in the conditions of 1 dry-steppe zone of West Kazakhstan region when cultivated for seed purposes. The optimal time for sowing sunflower in the conditions of zone 1 of West Kazakhstan region is sowing at an earlier date, when soil warms up at the depth of seeding up to 8-10°C. As a result of the studies carried out in the conditions of zone 1 of West Kazakhstan region, it was found that in order to obtain a full-fledged harvest, it is advisable to sow sunflower at an earlier date - when the soil warms up at the depth of seeding to 8–10 °C. Sowing during these periods has a positive effect on the growth and development of sunflower, indicators of the structural components of yield, increases the collection of oilseeds which is especially important in arid conditions of the region.

Keywords: *sunflower, sowing time, biometric indicators, yield, oil content*

The main direction in agro-industrial complex of the Republic of Kazakhstan is animal husbandry. Increasing meat production is currently the most important task facing Kazakhstan's domestic livestock industry. In the coming years, agriculture is tasked with increasing export potential of the country through the supply of quality domestic meat [1, 2].

In order to ensure food security of the Republic of Kazakhstan in the near future, according to the development program of agro-industrial complex until 2017-2021, in general, in the crop production industry, the work will continue to diversify crop production by replacing part of the wheat area with more demanded crops (sunflower, barley, corn, fodder crops). Over the past 5 years, more drought-resistant sunflower crops have been grown in 1 dry-steppe zone of West Kazakhstan region. In recent years in West Kazakhstan in connection with the diversification of agricultural commodity producers began to widely cultivate drought-resistant sunflower crops.

Sunflower seeds and products of their processing play an important role in the food complex of the country. Not only the satisfaction of the population's needs in edible vegetable oil depends on the level of the gross collection of seeds, but also, to a large extent, the provision of animal husbandry with high-protein feed. The production of sunflower products is profitable due to high added value. In recent years, selling price for sunflower in foreign markets was at the level of 100,000 tenge per ton, and in the world markets - from 150,000 tenge per ton.

In Europe, for diversification, it is proposed to use sunflower crops, along with other crops, which is probably related to its potential adaptation to climate change, competitiveness and attractiveness for food and energy production [3, 4].

Sunflower cultivation is relevant in the climatic conditions of West Kazakhstan, characterized by high heat supply and a long growing season. In recent years, sunflower crops in West Kazakhstan region have exceeded 45 thousand hectares, but the yield of oilseeds remains low (7.5-10.5 c/ha). In this regard, the development of adaptive technologies for the cultivation of sunflower is of particular relevance to increase productivity and expand the cultivated areas [5].

With intensive cultivation technology, sowing sunflower in optimal terms is one of the most important conditions that determine the receipt of timely, harmonious and full shoots and the further good development of plants. For a long time, sunflower was considered an early sowing crop. However, seeds of oilseeds and hybrids, when sown in cold soil, are affected by fungal diseases, quickly lose their viability, which leads to a strong thinning of crops and a significant decrease in yields. In this regard, in the literature there are various data on the timing of sowing (early, middle and late) [6, 7, 8].

In zone 1 of West Kazakhstan, adaptive technologies for sunflower cultivation are poorly studied. In this regard, we are conducting scientific research to study the elements of sunflower technology for this zone, namely the sowing time.

The research was carried out on the experimental field of Zhangir Khan WKATU within the framework of the grant funding program of the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan under the project AP05130172 "Development of adaptive technologies for the cultivation of forage and oilseeds in relation to the conditions of West Kazakhstan".

The soil of the experimental site is dark chestnut heavy loamy silty-powdery, physical clay in the arable horizon contains 51%. The topsoil contains 2.8–3.1% humus. The accumulation of carbonates begins in the lower part of horizon B, with a maximum in SK horizon at the depth of 70–80 cm. The amount of absorbed bases in the 0–10 cm layer is 27.8–28.0 mg eq per 100 g of soil. Ca predominates to the depth of 80 cm; deeper - Mg. Na content in the arable and subsoil horizons is low, 3.1–3.6% of the total absorbed bases. The soil in a one-and-a-half-meter layer contains 672.5 mm of moisture, and retains - 481.3 mm, of which the productive one is 236.7 mm, in the arable layer - 160.8, respectively; 102.1; 57.6 mm. The bulk density of soil varies from 1.22-1.28 g/cm^3 in the arable layer to 1.65-1.66 g/cm^3 at the depth of 80-120 cm.

According to the morphological characteristics of the genetic horizons of the profile and agrochemical parameters of the arable layer, the soil of the experimental site is characteristic of dry steppe zone of West Kazakhstan. The experiments used a hybrid of the Avangard sunflower. Seeding rate recommended for zone 1 of West Kazakhstan. Tillage system adopted in the 1st zone of West Kazakhstan region.

When conducting research on the study of sunflower, nitrogen and phosphorus mineral fertilizers were used in the recommended doses for the region.

The repetition of the experiment, the size and location of plots when setting up, organization of observations of the onset of phenological phases, the counts of the growth and development of sunflower were carried out according to generally accepted methods [9]. Statistical processing of research results by the method of variance, analysis using computer programs [10].

The choice of optimal sowing time is an important factor in obtaining timely and harmonious seedlings. The choice of sowing time, along with moisture availability, is determined by the temperature of soil surface. Creation of favorable conditions for plant growth in the initial period and possibility of successful weed control in the pre-sowing period depends on the correct choice of the sowing time and pre-sowing soil cultivation.

One of the important conditions for the start of germination of sunflower seeds is the conditions for water absorption, which largely depends on the permeability of the outer covers and water-absorbing properties of seeds. During the germination period, as a result of water absorption, the activity of numerous enzymes is activated, which contribute to the transformation of complex substances of the seed into simple ones, which then go to the formation of a seedling.

Seeds of modern varieties and hybrids contain relatively many protein compounds in which a relatively high content of glutamic acids, proline and phenylalanine, which determines high enzymatic activity of seeds during germination.

Due to genetic characteristics and a change in chemical composition of sunflower seed by high-oil seeds during germination, the intensity of the process of absorbing a large amount of water from the environment increases. The intensity of water absorption by sunflower seeds also depends on the content of productive moisture in the soil, which in turn is determined by the sowing time.

As shown by the research data, when sowing in 1 period, sunflower seedlings were observed 14 days after sowing. The field germination of sunflower when cultivated for oilseeds was 92.60% (46.3 thousand pieces of plants per 1 ha).

At the second sowing period, the field germination of sunflower was slightly lower than in the first sowing period. Field germination of sunflower when cultivated for oilseeds was 90.00% (45.0 thousand pieces of plants per 1 ha). Full shoots on the option 2 of the sowing date were noted 10 days after sowing.

As the observation data show, in comparison with the 1st period in the 2nd sowing period, the duration of the sowing-seedlings period decreased by 4 days. If at 1 sowing period the duration of the sowing-germination period was 14 days, then in the 2 sowing period the duration of this period was 10 days.

The dynamics of linear growth of sunflower depending on the sowing time. When cultivating sunflower for obtaining sustainable yields, it is important to form full biometric data of crops. At the same time, the evenness of plants in height is one of the most important indicators that determine manufacturability of sunflower. The success of high-quality agrotechnical care operations and, especially during harvesting, depends on evenness, which will significantly reduce technological losses in seed yield.

By morphology, sunflower has a powerful, leafy, green, herbaceous, in the lower part a lignified stem, ending with an inflorescence. The stem surface is rough, matte, covered with multicellular hairs of two types: large conical hairs have thickened shells and end with a tip, and smaller curved bead-like hairs consist of small rounded cells with thin walls.

According to the research of G.V. Pustovoit (1966), the stem length in sunflower varies from 60 cm in early ripening to 200 cm or more in mid-ripening varieties of oil group and up to 450 cm in plants of silage varieties. The diameter of the lower part of the stem in the optimal plant density ranges from 2 to 4 cm, in lonely plants it can reach 8 cm [11].

Observations have shown that, before flowering, anthode stimulates the growth of the stem and, to some extent, inhibits the growth of the plates of the upper leaves. After sprouting up to 2-3 pairs of leaves, sunflower plants grow slowly and can be easily oppressed by weeds. In studies prior to the budding phase in sunflower in all variants of the experiment, significant deviations in height were not observed. In the flowering phase, the plant height is almost completely formed.

The analysis of the dynamics of the increase in the height of sunflower during the growing season showed that at the beginning of the growing season, in the phase of 2 pairs of true leaves, plants of the 1st and 2nd sowing periods had a height of about 8.34-8.62 cm.

By the phase of 7-8 pairs of leaves, the linear growth of sunflower reached 23.10-26.50 cm in option 1, and 21.15-23.14 cm in option 2.

Subsequently, for the period from anthode formation to the full flowering phase, the increase in linear growth was the greatest and reached up to 50%. In the phase of anthode formation, the height of sunflower plants, depending on the sowing time, was 54.02-59.25 cm.

As the measurement data show, sunflower plants of the 1st sowing date, starting from the phase of 7-8 pairs of leaves, differed in height compared to the 2nd sowing period.

By the flowering phase, the height of 1 term sunflower plants had a height of 110 cm.

As it is known, in sunflower, the most active growth processes occur during the phases of anthode formation - flowering. During the period of anthode formation - flowering, not very favorable weather conditions developed (hot weather 35-40 ^{0}C, in the absence of precipitation), which in turn affected the growth processes of sunflower plants.

The growth rate during the noted period is associated not only with hydrothermal conditions, but this process is associated with the development of root system. During this period, there is an active absorption of nutrients and water. Further, from the phase of seed formation to the phase of complete ripeness, the supply of the forming seeds with nitrogen, phosphorus and other elements occurs mainly due to their mobilization from vegetative organs.

One of the reserves allowing to increase sunflower harvests in conditions of intensive farming is the widespread introduction of hybrids into production, adapted to local conditions.

Studies on the influence of the sowing time on the productivity of the studied hybrid of Avangard sunflower have shown that this hybrid practically responded well to the sowing time.

The formation of productivity elements of sunflower plants largely depends on biological characteristics of hybrids. High-oil hybrids are more productive when sowing in well-heated soil, when the soil temperature at the seeding depth is not less than + 8 + 10 °C, i.e. at the first sowing period.

The provision of sunflower plants with environmental factors is determined not only by soil-climatic and weather conditions, but to a large extent by their mutual influence in sowing, competition between them for light, water, nutrition. The less thickened the sowing, the more favorable conditions each plant develops, the more fully their potential yield is realized: more flowers are laid in the anthode, the lower the empty grain, the larger the seeds. The maximum sowing yield can be achieved only with the best satisfaction of the needs and full realization of the potential productivity of each plant.

Of the elements of the crop structure, which determine the productivity of one plant and the crop as a whole, a significant role belongs to the size of anthode and their grain content.

Observations have shown that anthode size is formed under the influence of the conditions of almost the entire growing season. In the initial period (up to 5 - 6 pairs of leaves), the rudiments of flowers are laid, which determines the possible fertility of plants, and, therefore, to a large extent, the future size of anthode. The degree of fertilization depends on the conditions during flowering, which is of no small importance for anthode growth. It was found that the conditions of moisture supply and mineral nutrition affect the size, completeness and weight of seeds in an anthode.

As the research data show, in the experiments, the indicators of the structural components of the yield depended on the timing of sunflower sowing. At the same time, the highest indicators of the elements of the crop structure were determined in the 1st sowing period. At the 1st sowing period, the indicators of the

sunflower yield structure were high compared to the 2nd sowing period. In this version, the diameter of the sunflower anthode is 14.0 cm, which is 1.8 cm more compared to the 2nd sowing period.

In an anthode of sunflower of the 1st sowing period, the number of seeds in the anthode with a mass of 1000 seeds of 38.12 g was 1097 pieces.

In the 2nd sowing period, 1013 achenes weighing 1000 seeds 34.15 g were determined on an anthode with a diameter of 12.8 cm.

As a result of the studies carried out in the conditions of zone 1 of West Kazakhstan region, it was found that in order to obtain a full-fledged harvest, it is advisable to sow sunflower at an earlier date - when the soil warms up at the depth of seeding to 8–10 °C. Sowing during these periods has a positive effect on the growth and development of sunflower, indicators of the structural components of yield, increases the collection of oilseeds (table 1, 2, figure 1), which is especially important in arid conditions of the region.

The highest yield is formed when sowing sunflower in the first period (third decade of April) - 1.71-2.81 t/ha, and when sowing in the second period (first decade of May) it significantly decreases by 0.37-0.74 tons/ha, while the level of seed oil content was 47.8-47.9 and 48.9-50.1%, oil collection - 0.74-1.21 and 0.60-0.91 t/ha, respectively.

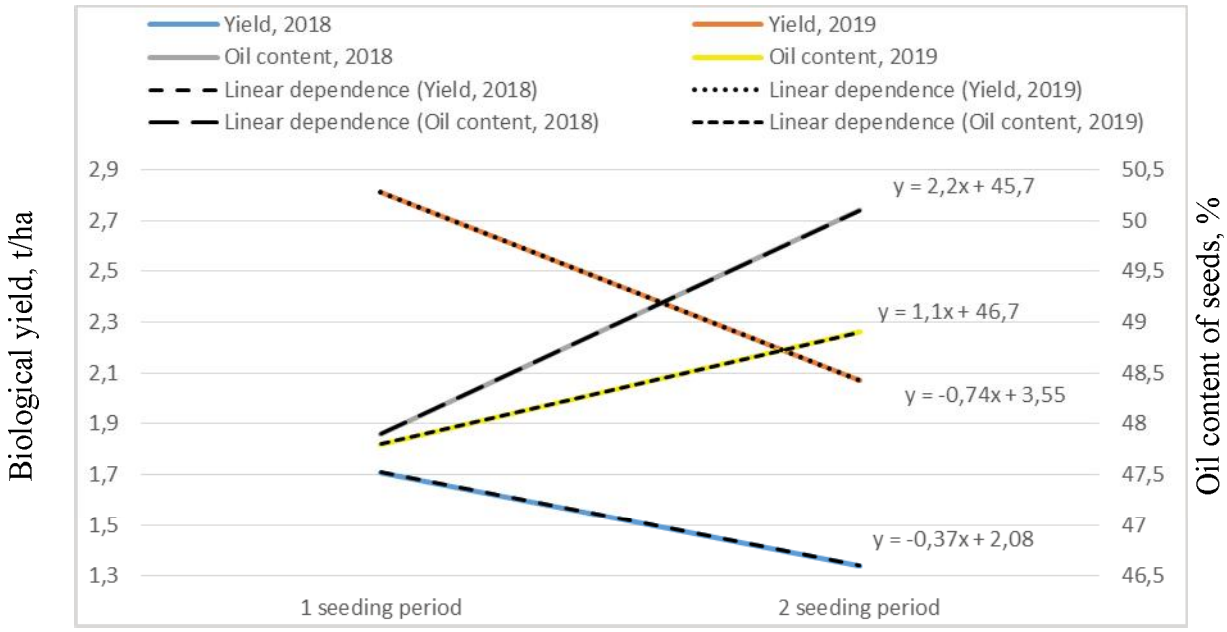

Figure 1 - Yield (t/ha) and oil content of seeds (%) depending on the timing of sunflower sowing

Table 1 - Plant density and structure elements of sunflower yield depending on the sowing time

Sowing date*	Plant density, thousand pcs/ha		Anthode area, cm^2		Number of achenes made in an anthode, pcs.		Weight of 1000 achenes, g		Huskness, %	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
1	41,0	39,7	158,3	379,9	1097	1532	38,1	46,1	22,0	23,0
2	38,8	39,8	128,6	314,0	1013	1348	34,1	38,6	24,0	24,8
LSD_{05}	2,4	2,1	23,1	25,6	75	89	1,5	1,7	0,8	0,6

* - 1 sowing period - the third decade of April, 2 sowing date - the first decade of May

Table 2 - Vegetation period and sunflower productivity depending on the sowing time

Sowing date*	Vegetation period, day		Biological productivity, t/ha		Seed oil content, %		Oil collection, t/ha	
	2018	2019	2018	2019	2018	2019	2018	2019
1	116	118	1,71	2,81	47,9	47,8	0,74	1,21
2	117	120	1,34	2,07	50,1	48,9	0,60	0,91
LSD_{05}	-	-	0,30	0,23	0,9	0,7	0,12	0,15

* - 1 sowing period - the third decade of April, 2 sowing date - the first decade of May

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ТҮЙІН

Жаңа жоғары өнімді сорттар мен гибридтерді енгізумен қатар күнбағыс өнімділігін арттырудың маңызды резерві агротехникалық әдістерді жетілдіру болып табылады, әсіресе егін салудың ең оңтайлы мерзімдерін таңдаудың маңызы зор. Бейіндік өсіру технологиясы кезінде күнбағыстың оңтайлы егіс мерзімі өсімдіктердің жақсы өніп-өсіп, дер уақытында, қаулап және толықтай өскін беруін анықтайтын маңызды шарттардың бірі болып табылады. Зерттеудің мақсаты өсімдік майын өндірушілерді сапалы шикізатпен қамтамасыз ету үшін күнбағыс өсірудің бейіндік технологияларының элементтерін зерттеу болып табылады. Жүргізілген зерттеулер нәтижесінде Батыс Қазақстан облысының 1-ші құрғақ далалық аймағы жағдайында тұқымдық мақсатта өсірілетін күнбағысты өсірудің бейіндік технологиясының элементтерін, атап айтқанда себу мерзімдерін зерттеу жөніндегі деректер алынды. Құрғақ дала аймағында күнбағыс егу ертерек жүргізілуі керек. Жүргізілген зерттеулерде орта есеппен 3 жыл ішінде май тұқымдарының ең жоғары биологиялық шығымдылығы 1 себу мерзімінде - 20,07 ц/га, ең аз 2 себу мерзімінде - 15,34 ц/га болды. Майлылықпен және биологиялық өнімділікпен қатар себу мерзімін кешіктіру майдың шығуын 1,19 ц/га немесе 13,77%-ға төмендетеді.

РЕЗЮМЕ

Важным резервом повышения урожайности подсолнечника наряду с внедрением новых высокопродуктивных сортов и гибридов, является совершенствования агротехнических приёмов, особенно важен выбор наиболее оптимальных сроков посева. При адаптивной технологии возделывания посев подсолнечника в оптимальные сроки является одним из важнейших условий, определяющих получение своевременных, дружных и полных всходов и дальнейшее хорошее развитие растений. Целью исследований является изучение элементов адаптивных технологии возделывания подсолнечника для обеспечения производителей растительного масла качественным сырьем. В результате проведенных исследований получены данные по изучению элементов адаптивных технологии возделывания подсолнечника, а именно сроков посева в условиях 1 сухо-степной зоны Западно-Казахстанской области при возделывании на семенные цели. В условиях сухо-степной зоны посев подсолнечника целесообразно произвести в более ранние сроки. В проведенных исследованиях в среднем за 3 года наибольшая биологическая урожайность маслосемян была у 1 срока посева – 20,07 ц/га, наименьшая в 2 сроке посева – 15,34 ц/га. Наиболее высокий выход масла 8,64 ц/га получен при посеве подсолнечника до 5 мая. Задержка срока посева наряду с масличностью и биологической урожайностью снижает выход масла на 1,19 ц/га или на 13,77%.