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**GROWTH AND DEVELOPMENT OF BLACK SAXAUL (*HALOXYLON
APHYLLUM*) DEPENDING ON THE MAIN METHODS OF TILLAGE IN
KAZAKHSTAN**

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Abstract

Because of the intensive use of natural resources and increased anthropogenic loads, a tense ecological situation has developed in the Western regions of Kazakhstan. This has led to the necessity of urgent measures among which is enhancing areas for black saxaul forest plantations.

Based on the study conducted at Samsk State Institution for Protection of Forests and Wildlife in Mangystau Region the authors of the article have proved that the main methods of tillage impact on the growth and survival rate of black saxaul in the arid conditions of Western Kazakhstan. The article presents the results of the effectiveness for the planting of black saxaul forest plantations with various methods of tillage.

It has been known that agrotechnical methods of growing plantations are aimed at improving the water regime of the soil through additional accumulation, conservation and rational use of soil moisture. The system of tillage contributes to the creation of these conditions in many respects. The choice of the optimal method of tillage has had a positive effect on the survival rate and intensity of growth and development of the saxaul plantations.

Keywords: tillage methods; black saxaul; forest plantations; average indicators; condition; survival rate; height.

Introduction

According to the materials of the RSE “Kazakh Forest Inventory Enterprise” for 2018 there are 17 821,2 million hectares are occupied by saxaul plantations in Kazakhstan [1]. However, in recent decades saxaul plantations have been strongly damaged because of intensive industrial and agricultural exploitation.

Because of the intensive use of natural resources and increased anthropogenic loads, a tense ecological situation has developed in the Western regions of Kazakhstan. This situation requires the adoption of urgent measures aimed at improving the ecological situation in the region, among which the most important are the improvement of methods for black saxaul seed base on a breeding and genetic basis, the development of agricultural techniques for growing planting material in the nurseries as well as the development of

afforestation technology for plains and barkhan sands using valuable shrubs and semi-shrubs. At the same time, special attention is paid to the expansion of saxaul plantations because they perform a soil-protective, pasture-protective, climate-regulating role as well as contribute to the environmental improvement.

The need to expand the areas of saxaul plantations is particularly acute in Western Kazakhstan, where excessive exploitation of plantations as a fuel wood, carried out without observing the measures of natural regeneration, with unregulated livestock grazing has led to their complete disappearance over vast areas. Thus, the productivity of the remaining saxaul plantations has been greatly reduced.

According to the reasons above it is necessary to develop the technology for growing saxaul plantations that takes into account the interests of

forestry and agriculture and allow both forest and pasture land to be obtained at the same time. That is why purpose of this research was to develop a scientifically based technology for growing saxaul plantations with minimal labor and money. The technology allows achieving high survival rate, intensity of growth and development of saxaul plantations in Western Kazakhstan.

Based on the study of natural and artificial phytocenoses in arid regions, analysis of the experience for growing saxaul plantations and setting up field experiments, the technology of growing socially significant low-cost and durable black saxaul plantations in arid regions has been developed.

The scientific novelty of this research was that for the first time in the arid conditions of Western

Materials and methods

Usually established forest plantations in arid conditions has very low survival rate. This is mainly due to the emerging discrepancy between the biological potential of the habitat conditions and the physiological needs of forest plantations.

The low survival rate of established plantations is also predetermined by the impossibility of optimizing their moisture supply. Nevertheless, in the presence of available groundwater, it is possible to grow forest plantations for a long time, subject to the application of appropriate agrotechnical measures.

The outcome of cultivated plants is mainly determined by the impossibility of optimizing their moisture supply. Nevertheless, in the presence of available groundwater, it is

Kazakhstan, different tillage methods for black saxaul plantations were tested and the most rational methods of tillage have been established. In addition, created technologies for durable forest crops has great economic importance, since their use significantly increases the forest cover of the territory and improves the living conditions of the local population.

The practical significance of this research lies in the fact that the results of the agricultural technology of growing saxaul forest plantations can be used by design organizations in the development of projects for artificial cultivation of crops in arid conditions, as well as state forestry institutions of Western Kazakhstan in the practice of silvicultural work.

possible to grow forest plantations for a long time, subject to the application of appropriate agrotechnical measures.

An analysis of scientific research and literature references shows that conservational tillage has a positive effect on the process of maintaining soil moisture. According to the moisture content in the soil, it is preferable to use the soil treatment system such is 1-year black bare fallow. An important factor in soil treatment is the depth of its plowing. Also, the results of previous studies have shown that that deep plowing of the soil contributes to a greater preservation of its moisture content. Nevertheless, deep plowing in combination with 1-year black bare fallow contributes to the greatest accumulation of soil moisture. However, 2-year bare fallowing system does not give positive results in

maintaining soil moisture and from the economic point of view it does not fully justify itself [2-8]. Also, spring plowing does not have a positive effect on the preservation of soil moisture, which is explained by the drying up of the soil during the growing season, as well as autumn plowing aggravates this process.

Consequently, this research conducted in Samsk State Institution for Protection of Forests and Wildlife in Mangystau Region from 2018 to 2020 studied the effectiveness of the establishment of black saxaul plantations using various methods of tillage. In 2020, there was an inventory of the black saxaul plantations established with 1-year-old standard seedlings in 2018. Based on the inventory results the following tillage methods were chosen as experimental options:

1 – Fall moldboard plowing to a depth of 25-27 cm

2 – Spring moldboard plowing to a depth of 25-27 cm

3 – Flat-cutting tillage to a depth of 40 cm

4 - Without tillage (control)

In the zone of insufficient moisture, the successful cultivation of forest crops is largely determined by the proper soil management system, which should be aimed at improving its physical and biological properties and thereby creating favorable conditions for the survival rate and growth of young plants. Tillage improves soil physical and mechanical properties; it is aimed at the destruction of weeds, providing moisture to the lower horizons, that contributes to a more powerful growth of the root systems of young plants. It is well known that the

determining indicators in assessing the effectiveness of crop growing are the survival rate and growth of plants. Additionally, during tillage for planting forest crops, the types of growing conditions, the state of forest-cultivated areas, and the biological properties of the species introduced into the crops should be taken into account.

In the process of this research, the methodological recommendations of V.V. Ogievsky and A.A. Hiron were used [9, 50 p.]. The laying of the sample plots was carried out according to GOST 16128-70 and OST 56-69-83 [10]. The allocation and description of the sample plot were accompanied by familiarity with the surrounding area and additions and adjustments to the data obtained from the sample plots. Sample plots in kind were marked with labels and linked to permanent landmarks.

The survival rate, growth and condition of plantations were determined during their autumn inventory. For each type of plantations, three sample plots were laid, on which the survival rate, height, crown projection diameters along and across the row, and state were determined.

The height of bushes up to 3-year-old was measured with a measuring rail with an accuracy of 1 cm, and older with an accuracy of 5 cm, the annual growth of the crops in height was determined by the method of A.A. Molchanov and V.V. Smirnov [11].

The survival rate was determined by a complete enumeration of plants on the sample plots for each lane or variant after the end of the growing season. The assessment of the state of saxaul plants on all sample plots was

assessed according to the scale of G.G. Wiebe [12].

Results

As was mentioned above, the main indicator of the success of silvicultural work was the survival rate and growth, which more fully characterize the physiological state of plants in connection with transplantation. The survival rate of seedlings was closely related to the amount of moisture in the soil at the time of planting and in the first 10-15 days after it [13–24]. In our studies, these indicators were closely related with the methods of tillage (Table 1, Figures 1, 2).

Table - 1. Survival rate and growth of 3-year-old black saxaul crops depending on the methods of tillage

Number of options	Tillage method	Average indicators		Status, points
		Survival rate, %	Height, cm	
1	Fall moldboard plowing to a depth of 25.0-27.0 cm	45,2	131,4 ± 5,9	C ₂
2	Spring moldboard plowing to a depth of 25.0-27.0 cm	40,5	117,4 ± 5,4	C ₂
3	Flat-cutting tillage to a depth of 40.0 cm	48,5	139,0 ± 6,2	C ₁
4	Without tillage (control)	31,7	93,6 ± 3,9	C ₃

Fall moldboard plowing Spring moldboard plowing

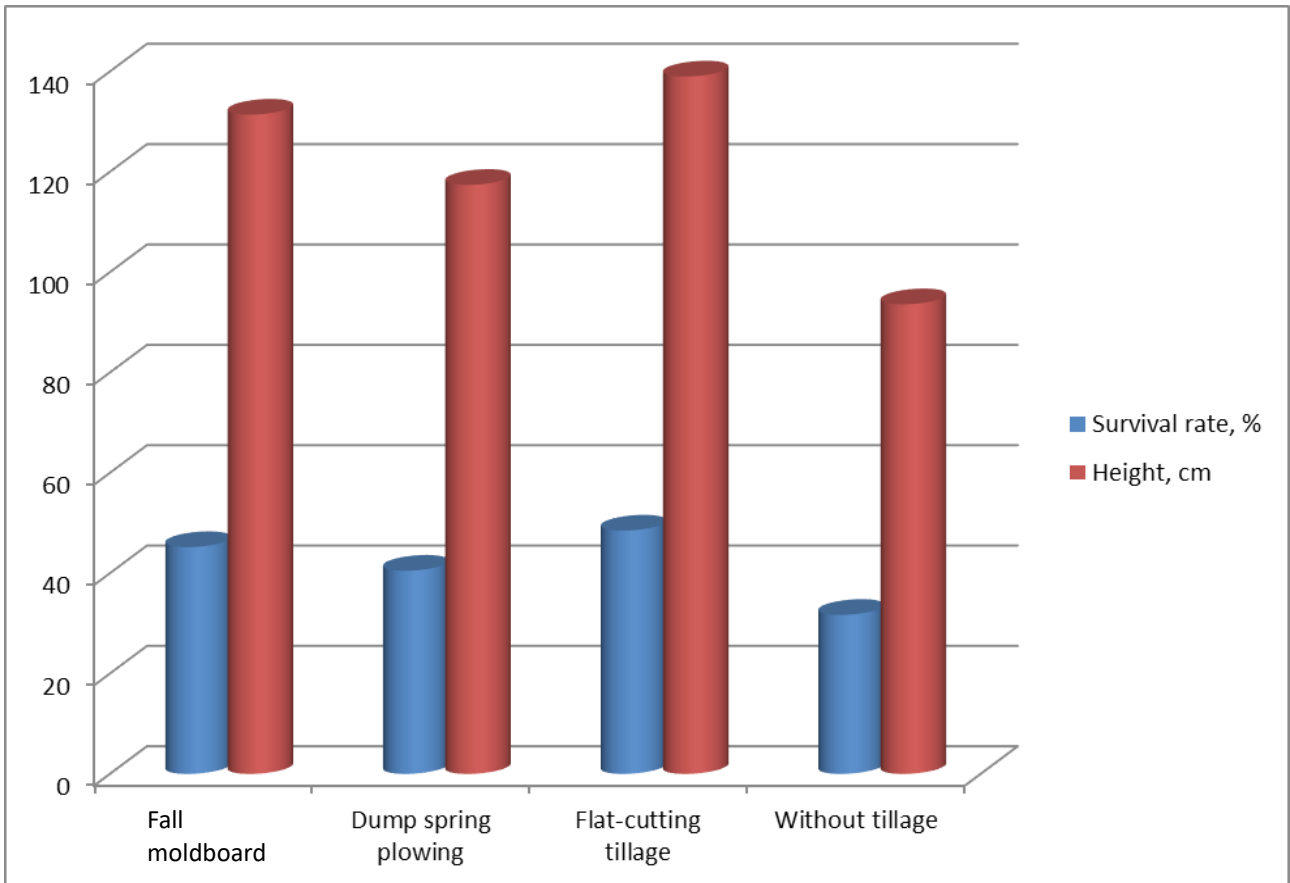


Figure - 1. Survival rate and growth of 3-year-old black saxaul crops depending on the method of tillage



Spring moldboard plowing to a depth of 25.0 – 27.0 cm



Fall moldboard plowing to a depth of 25.0 – 27.0 cm



Flat-cutting tillage to a depth of 40.0 cm



Without tillage (control)

Figure – 2. 3-year-old black saxaul forest crops established using different tillage methods

According to the results showed in the Table 1 (Figure 1, 2), the best height of 3-year-old black saxaul crops was traced in the variant with flat-cutting tillage, where the height of saxaul is higher than with fall moldboard plowing, spring moldboard plowing and without tillage (control) by 7.6, 21.6 and 45.4 cm respectively. Therefore, the flat-cutting tillage is

Discussion

In addition, according to the received results of this study it was noted that the variants of experiments with a depth of tillage of 25-27 cm had

more effective that other methods. Nevertheless, the best indicators for the length of the projection of crowns both along and across the row were also noted for flat-cutting tillage to a depth of 40 cm, where the length of the crown along the row is 2.1, 23.1 and 53.3 cm longer than with options 1, 2 and 4 respectively.

a lower survival rate and growth, and the lowest rates were in the variant with spring plowing. On the control (without tillage) variant, the plants had

the worst indicators. A noticeable increase in plant height was identified when tilling soil up to 40 cm deep, compared with other options, ranges from 5.5% (autumn plowing) to 14.9% (spring plowing). The difference in the direction of increasing the survival rate of seedlings for autumn moldboard plowing compared to spring moldboard plowing was 13.9%, and without tillage was 28.6%. This is explained by the fact that in the variant without tillage, there is an acute shortage of moisture in the soil, and with deep tillage, moisture supply increased, which favorably affects the survival rate and growth of black saxaul.

Conclusion

Analyzing the data obtained in this research on the primary tillage for black saxaul forest plantations in Western Kazakhstan (Samsk State Institution for the Protection of Forests and Wildlife in Mangistau Region), based on the growth and survival rate

- Primary tillage increases the growth of saxaul plants in height by 40.3-48.5%, compared with the control (without tillage).

- Fall moldboard plowing to a depth of 25-27 cm and flat-cutting tillage to a depth of 40 cm increase the survival rate of black saxaul plants by

The state of 3-year-old plantings of black saxaul is assessed by index C1 and C2 (annual growth over 30 cm and within 5–30 cm) in variants with primary tillage, and in the variant without tillage this index decreases to C3 (annual growth less than 5 cm). This is explained by the fact that in the variants without tillage, there is an acute shortage of moisture in the soil and the saxaul undergoes a restructuring of the water regime and other functions. Thereby so called “a physiological barrier” is erected, due to which growth processes are suppressed and, consequently, the plant adapts to unfavorable conditions.

of 3-year-old saxaul crops, the following conclusions can be drawn:

- When growing forest crops of black saxaul, it is best to carry out flat-cutting tillage to a depth of 40 cm, which ensures high efficiency, increases the growth and survival of plants.

13. and 16.8%, respectively, compared to the variant without tillage.

- The state of forest plantations of black saxaul in variants with primary tillage corresponds to the index C1 and C2, while without tillage the index decreases to C3.

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ҚАЗАҚСТАНДАҒЫ ТОПЫРАҚТЫ ӨНДЕУДІҢ НЕГІЗГІ ТӘСІЛДЕРІНЕ БАЙЛАНЫСТЫ ҚАРАСЕКСЕУІЛДІҢ (HALOXYLON ARHYLLUM) ӨСУІ МЕН ДАМУЫ

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Түйін

Табиғи ресурстарды қарқынды пайдалану және антропогендік жүктемелердің артуы салдарынан Қазақстанның батыс өңірлерінде шиеленісті экологиялық жағдай қалыптасты. Бұл шұғыл шаралар қабылдау қажеттілігіне алып келді, оның ішінде қара сексеуіл орман екпелері үшін аудандарды кеңейту (*Haloxylon aphyllum*).

Маңғыстау облысының ормандар мен жануарлар дүниесін қорғау жөніндегі Сам мемлекеттік мекемесінде жүргізілген зерттеулердің негізінде мақала авторлары Батыс Қазақстанның құрғақ жағдайында қара сексеуілдің өсуі мен жерсінуіне топырақты өңдеудің негізгі әдістерінің әсерін дәлелдеді. Мақалада топырақты өңдеудің әртүрлі тәсілдерімен қара сексеуіл орман екпелерін құру тиімділігінің нәтижелері келтірілген.

Барлығына мәлім, екпелерді өсірудің агротехникалық әдістері топырақ ылғалдылығын қосымша жинақтау, сақтау және ұтымды пайдалану арқылы топырақтың су режимін жақсартуға бағытталған. Бұл жағдайлардың пайда болуына көбінесе топырақты өңдеу жүйесі ықпал етеді. Топырақты өңдеудің оңтайлы әдісін таңдау қара сексеуіл екпелерінің жерсінуіне және өсу мен даму қарқындылығына оң әсер етеді.

Кілт сөздер: топырақ дайындау жүйесі; қара сексеуіл; орман дақылдары; орташа көрсеткіштері; жай-күйі; жерсінуі; биіктігі.

РОСТ И РАЗВИТИЕ САКСАУЛА ЧЕРНОГО (*HALOXYLON APHYLLUM*) В ЗАВИСИМОСТИ ОТ ОСНОВНЫХ СПОСОБОВ ОБРАБОТКИ ПОЧВЫ В КАЗАХСТАНЕ

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Аннотация

Вследствие интенсивного использования природных ресурсов и возросших антропогенных нагрузок в западных регионах Казахстана сложилась напряженная экологическая ситуация. Это привело к необходимости принятия срочных мер, среди которых расширение площадей для лесных культур саксаула черного (*Haloxylon aphyllum*). ых в Самском государственном учреждении по охране лесов и животного мира Мангистауской области, авторами статьи доказано влияние основных приемов обработки почвы на рост и приживаемость саксаула черного в засушливых условиях Западного Казахстана. В статье представлены результаты эффективности создания лесных культур саксаула черного при различных способах обработки почвы.

Как известно, агротехнические приемы выращивания насаждений направлены на улучшение водного режима почвы за счет дополнительного накопления, сохранения и рационального использования почвенной влаги. Созданию этих условий во многом способствует система обработки почвы. Выбор оптимального способа обработки почвы оказывает положительное влияние на приживаемость и интенсивность роста и развития насаждений саксаула черного.

Ключевые слова: система подготовки почвы; саксаул черный; лесные культуры; средние показатели; состояние; приживаемость; высота.