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«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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FEATURES OF TECHNOLOGY FOR CULTIVATING CORN FOR GRAIN UNDER DRIP IRRIGATION ON SEREOZEM SOILS

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Abstract. This article discusses the features of the technology for growing corn for grain under drip irrigation on gray soils in the south of Kazakhstan. In the south of Kazakhstan, reclamation measures carried out to increase soil fertility when growing crops are especially relevant for irrigated lands. In the conditions of southern Kazakhstan, the reclamation state of irrigated lands and analysis of the use of irrigation water shows that the problem of sustainable development of irrigated agriculture can be solved mainly through the use of water-saving irrigation technologies. The issue of using water-saving drip irrigation technology for corn on gray soils is currently limited by as a consequence insufficient scientific experience and, the lack of scientifically based guidelines on the technology of drip irrigation of corn for grain. The development of drip irrigation technology for corn and its scientific substantiation will significantly expand the scope of application of drip irrigation systems and, with consistently efficient production operation, will provide the opportunity to obtain high yields.

Keywords: Water-saving technologies, reclamation hydrogeology, drip irrigation, corn, sierozem soils

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СҰР ТОПЫРАҚТЫ ЖЕРЛЕРДЕ ТАМШЫЛАТЫП СУАРУ АРҚЫЛЫ ДӘНДІК ЖҮГЕРІНІ ӨСІРУ ТЕХНОЛОГИЯСЫНЫҢ ЕРЕКШЕЛІКТЕРІ

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Аннотация. Бұл мақалада Қазақстанның оңтүстігіндегі сұр топырақты жерлерде тамшылатып суару арқылы дәндік жүгеріні өсіру технологиясының ерекшеліктері қарастырылған. Ауыл шаруашылығы дақылдарын өсіру кезінде топырақтың құнарлылығын арттыру мақсатында өткізілетін мелиоративтік іс-шаралар, әсіресе Қазақстанның оңтүстігіндегі суармалы жерлер үшін өзекті. Суармалы жерлердің мелиоративтік жағдайы мен суаруға арналған суларды пайдалануды талдау Қазақстанның оңтүстігі жағдайында суармалы егіншіліктің тұрақты даму проблемасын су үнемдеу технологияларын қолдану негізі есебінен шешуге болатындығын көрсетеді. Қазіргі уақытта жүгеріні сұр топырақта тамшылатып суару арқылы су үнемдеу технологиясын қолдану мәселесі ғылыми тәжірибенің жеткіліксіздігімен және соның салдарынан дәндік жүгеріні тамшылатып суару технологиясы бойынша ғылыми негізделген әдістемелік ұсынымдардың болмауымен шектеледі. Жүгеріні тамшылатып

суару технологиясын әзірлеу және оның ғылыми негіздемесі тамшылатып суару жүйелерін қолдану аясын едәуір кеңейтуге мүмкіндік береді және өндірістің тұрақты тиімді жұмысымен жоғары өнім алу мүмкіндігін қамтамасыз етеді.

Түйін сөздер: Су үнемдеу технологиялары, мелиорациялық гидрогеология, тамшылатып суару, жүгері, сұр топырақтар

Алғыс. *Бұл мақала агроөнеркәсіптік кешен саласындағы қолданбалы ғылыми зерттеулерді жүзеге асыру шеңберінде 2021–2023 жылдарға арналған «Жаңа суарылатын жерлерді енгізу, қолданыстағы суармалы жерлердегі суару жүйелерін реконструкциялау және жаңғырту кезіндегі суландырудың технологиялары мен техникалық құралдары» ғылыми-техникалық бағдарламасы (ИРН BR10764920) аясында орындалды».*

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ОСОБЕННОСТИ ТЕХНОЛОГИИ ВОЗДЕЛЫВАНИЯ КУКУРУЗЫ НА ЗЕРНО ПРИ КАПЕЛЬНОМ ОРОШЕНИИ НА СЕРОЗЕМНЫХ ПОЧВАХ

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Аннотация. В данной статье рассмотрены особенности технологии выращивания кукурузы на зерно при капельном орошении на сероземных почвах юга Казахстана. Мелиоративные мероприятия, проводимые с целью повышения плодородия почв при выращивании сельскохозяйственных культур особенно актуальны для орошаемых земель юга Казахстана. Мелиоративное состояние орошаемых земель и анализ использования оросительных вод показывает, что в условиях юга Казахстана проблему устойчивого развития орошаемого земледелия можно решать преимущественно за счет применения

водосберегающих технологий орошения. Вопрос применения водосбрегающей технологии капельного орошения кукурузы на сероземных почвах в настоящее время ограничивается недостаточным научным опытом и, как следствие, отсутствия научно-обоснованных методических рекомендаций по технологии капельного орошения кукурузы на зерно. Разработка технологии капельного орошения кукурузы и ее научное обоснование позволит существенно расширить область применения капельных систем орошения и при стабильно эффективной работе производства обеспечит возможность получения высоких урожаев.

Ключевые слова: водосберегающие технологии, мелиоративная гидрогеология, капельное орошение, кукуруза, сероземные почвы

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Introduction

In the south of the country is irrigated using the drip method, mainly gardens, vineyards, vegetables, melons, and cotton. In this regard, corn is a relatively new crop, for which the use of this method of irrigation is still not widespread.

The use of the drip irrigation method allows for economical use of water and uniform distribution of moisture over the irrigation area, and the task of such research is to establish the regime and technology for drip irrigation of forage crops.

Despite some knowledge of this relatively new method of irrigation, it is necessary to carry out additional research work to study and develop technology for drip irrigation of forage crops.

The widespread introduction of resource-saving technologies in the context of the emerging shortage of irrigation water will ensure the efficient conduct of agricultural production in the region. This is a prerequisite for the transition of the Republic of Kazakhstan to a “Green economy” in the field of agriculture (On approval of the Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to the “Green Economy” for 2021–2030).

The relevance of the study is dictated by the need to study the features of the technology for cultivating corn for grain when using water-saving irrigation technologies on various soils in the south of Kazakhstan.

Purpose of the study: to consider the features of the technology of cultivating corn for grain using drip irrigation on gray soils.

Corn is one of the grain and fodder crops, the volume of cultivation of which directly or indirectly determines the level of development, efficiency, and, accordingly, the degree of profitability of agricultural enterprises, especially livestock farming, as well as grain processing and biofuel production. Corn is also the most important grain crop in agricultural production in many countries and is used for feed in livestock farming, as a raw material for the food industry, and is widely consumed by the population as a food product.

Corn is of great agrotechnical importance. As a row crop, it leaves behind fields free of weeds, in a loose state, with a large supply of organic matter in the form of roots and stem residues. Therefore, it is a for other crops good predecessor.

Materials and basic methods

The south of Kazakhstan is a favorable region for growing corn because the sum of active and effective air temperatures and a long period without sub-zero temperatures make it possible to grow this crop. For example, the average long-term sum of active temperatures with air temperatures above 100C in the south of Kazakhstan is 2700–3300 ^{0}C, and for the full formation of a corn crop, the required sum of active temperatures is 2800–2900 ^{0}C (Data from the National Hydro meteorological Service of the Republic of Kazakhstan).

Most of the irrigation systems in the south of Kazakhstan were built in 1965–1985. Over the past period, hydraulic structures and canals have practically exhausted their resources and require major repairs and reconstruction (Ibrayev et. al., 2022).

The efficiency coefficient (efficiency) of main and inter-farm canals varied within the range of 0.52–0.80. The established discrepancies in the efficiency indicators of main and off-farm canals are due to the degree of damage to their lining and the reliability of determining water flow rates at water outlets to the farm. In the arid conditions of southern Kazakhstan, the problems of rational use of water resources and the introduction of effective irrigation methods that ensure sustainable and high crop yields while maintaining soil fertility become particularly relevant. A promising method for optimizing plant development conditions is resource-saving irrigation technologies, such as drip irrigation and fine sprinkling.

The accumulated literature review indicates that the value of the lower threshold of optimal soil moisture during irrigation varies within a fairly wide range - from 60 to 85 %. This range of variation depends on many factors: soil-climatic, meteorological conditions, the level of groundwater and the degree of its mineralization, the size of the calculated soil layer (wetting depth during irrigation), fertilizer, the level of agricultural technology, biological characteristics of varieties (hybrids) and the size of the harvest (Ibrayev et. Al., 2022).

The choice of technical means and technological operations to improve irrigation systems should be carried out on the basis of economically feasible limits for increasing the coefficient efficiency of the irrigation network and irrigation technology.

Corn produces high yields on loose, well-permeable, but at the same time moisture-intensive soils. Soils for which corn cultivation must contain a certain supply of moisture, and they must be well aerated (they contain nutrients that are easily accessible to plants). Such properties are possessed by soils of average mechanical composition (medium and light loams), rich in organic matter (chernozem, chestnut, and their analogs) (*Mirdadayev* et al., 2022).

Many researchers have found that corn responds well to deep plowing, which promotes better soil moisture after watering and the use of moisture by plants (Salah et. al., 2008). During shallow plowing, the compacted subsoil layer prevents water from penetrating the lower layers, and during the non-irrigation period, moisture is easily lost

in such areas, which sharply reduces the efficiency of irrigation. At the same time, with deep plowing, increased soil permeability lasts from one to three years. Therefore, the most appropriate plowing depth for corn should be considered to be at least 30 cm, and if the topsoil layer is smaller, 20 cm with a deepening of the subsoil layer to 30 cm. Corn responds well to the plowing depth when applying fertilizers (Ospanbaev et. al., 2021).

The best are predecessor's leguminous crops.

Corn can be cultivated without reducing yield as a monoculture for three to four years in a row, only in areas of sufficient moisture or in the presence of irrigation, as well as subject to the annual application of an average rate of complete mineral fertilizer and the use of organic fertilizer once per rotation for the first and second the second year of its cultivation.

Of the row crops, they are sugar beets and sunflowers most unsuccessful predecessors, because these crops dry out the soil, and sugar beets also remove many nutrients, including zinc, which is necessary for the corn plant.

Results

For the rational use of water in conditions of scarcity of water resources, a technology has been developed for cultivating fodder crops using the drip irrigation method, using the example of corn for grain on gray soils. The technology was developed for use on the lands of southern Kazakhstan and further use in agricultural formations.

Natural research conditions in natural and corresponding agro-climatic moisture zones make it possible to grow corn and other crops on irrigated lands using drip irrigation.

The advantages of drip irrigation are:

- Losses of fertilizers and nutrients are minimized due to localized application and reduced leaching.
- Irrigation efficiency is high with proper management.
- Field leveling is not required.
- Irregularly shaped fields are easily adjusted.
- Recycled non-potable water can be safely used.
- Moisture in the root zone can be maintained at field capacity levels.
- Soil type plays a less important role in watering frequency.
- Soil erosion is reduced.
- Weed growth is reduced.
- The water distribution is extremely uniform, controlled by the power of each nozzle.
- Labor costs are less than other irrigation methods.
- The change in flow can be adjusted by adjusting the valves and drippers.
- Fertigation can be easily incorporated with minimal fertilizer input.
- The foliage remains dry, which reduces the risk of disease.
- Typically operates at lower pressure than other types of pressure irrigation

The disadvantages of drip irrigation are:

- High initial cost of water-saving technologies and irrigation techniques.
- The sun can attack tubing used for drip irrigation, shortening its life.
- Risks of plastic degradation affecting soil and food crops. With many types of

plastic, when the sun breaks down the plastic, making it brittle, chemicals are released into the environment.

- If water is not filtered properly and equipment is not properly maintained, clogging or biofouling can result.
- Drip irrigation may be unsatisfactory if sprinkler irrigation is required to activate herbicides or fertilize.
- Drip tape results in additional post-harvest cleanup costs. Users should plan to wind drip tape, dispose of it, recycle or reuse it.
- A waste of water, time and crops if installed incorrectly. These systems require careful consideration of all relevant factors such as terrain, soil, water, crop and agro-climatic conditions, as well as the suitability of the drip irrigation system and its components.
- In lighter soils, drip irrigation may not be able to wet the soil surface for germination. Requires careful consideration of installation depth.
- Polyvinyl chloride pipes are often damaged by rodents, requiring replacement of the entire pipe and increasing costs.
- Drip irrigation systems cannot be used to repair damage from overnight frosts (as is the case with sprinkler irrigation systems).

Thus, drip irrigation technology provides optimal water supply to plants and nutrition, taking into account the phases of plant development and provides for an increase in yield by 1.5–2 times. This technology for cultivating corn for grain with drip irrigation provides for compliance with all agrotechnical methods for growing crops under the optimal irrigation regime established for this method of irrigation.

Discussion

In the south of Kazakhstan, gray soils and light chestnut soils are more common, which also require an appropriate soil cultivation system, and in some cases, irrigation. It should be remembered that land fertility completely depends on the farming system.

Unfortunately, wind erosion of soils in different regions of the country reminds us of itself. Today, dust storms also occur in the south of Kazakhstan. To preserve soil fertility and improve structure, experts recommend crop rotations. In the south of the republic, this can be various combinations of agricultural crops.

It is important to note here that the decline in soil fertility may also worsen with climate change, which in turn can lead to a loss of agrobiodiversity and a deterioration in the water regime of soils and plants. Land degradation and desertification have negative impacts on ecosystems and increase vulnerability to global warming.

The article presents the conclusions of experiments in growing corn for grain using drip irrigation, which were carried out in field and laboratory conditions, carried out at KazSRIWE LLP in a dry, foothill semi-desert zone (Ku = 0.25–0.20), on gray soils in the south of Kazakhstan.

Depending on the types of land in irrigated agricultural landscapes, special attention is paid to such qualitative indicators as humus content, particle size distribution, pH, solonetsous content and salinity, erosion, waterlogging and swampiness, rockiness, steepness and aspect of the slope, degree of moisture in individual massifs, etc. (*Zhaparkulova* et. al., 2021).

The selection of experimental production sites (EPS) for studying technological methods of cultivating corn for grain was carried out taking into account the natural and economic conditions of the site, the agrochemical and granulometric composition of the soils of the experimental site, the configuration of irrigated lands and the features of the placement of irrigation equipment.

To irrigate crops, drip irrigation systems were installed on peasant farms.

The soils of the study area are ordinary sierozems. The thickness of the humus horizon is 35–50 cm. The humus content in the 0.3 m layer is in the range of 1.5–1.9 %. The amount of gross nitrogen is 0.120–0.134 %. The absorption capacity is low (8–10 mg/eq per 100 g of soil), and the reaction of the soil solution is alkaline. In terms of mechanical composition, the soils are light, medium, and heavy loamy, non-saline. The total amount of water-soluble substances is 0.7–0.1 % (Mahdi Gheysari and et al, 2017).

The chemical analysis and mechanical and mineral composition of the soil were determined in the laboratory of the Kazakh Scientific Research Institute of Water Economy LLP, Taraz.

The results of chemical analysis of soils show that the humus content in the arable horizon is in the range of 0.42–1.25 % (Table 1).

Table 1 - Chemical analysis of soils in the study area

Sampling depth, cm	Humus, %	Gross, %		Movable, mg/100 g		
		N	P_2O_5	NO_3	P_2O_5	K_2O
0–20	1,253	0,124	0,138	2,259	1,083	36,54
20–40	0,428	0,060	0,112	3,249	0,479	19,68
40–60	1,022	0,093	0,123	2,273	0,833	24,90

The content of gross nitrogen in horizons 0–20 cm is 0, 12 %, 20–40 cm - 0.06 % and in horizons 40–60–0, 1 %. The phosphorus content in the arable horizon is 0, 11–0, 14 % in layers from 20 to 60 cm - 0, 11–0, and 12 %. The chemical analysis of the soils of the experimental plot shows that, according to all characteristics, the nutrient content, in general, corresponds to this type of soil; however, there is a tendency towards a decrease in their values (Yang et .al., 2018).

Therefore, when setting up field experiments, it is necessary to apply both organic and mineral fertilizers in doses recommended by scientific institutions in the region.

The mechanical composition of the soils in the study area is shown in Table 2.

Table 2 - Mechanical composition of soils in the study area

Sample depth, cm	Fraction sizes, mm						Variety according to granulometric composition	Soil name
	sand		dust		clay			
	1,0–0,25	0,25–0,05	0,05–0,01	0,01–0,005	0,005–0,001	0,001		
0-20	4,10	6,3	36,24	14,88	12,88	25,60	53,36	loam heavy
20-40	3,32	16,28	27,2	24,8	13,84	14,56	53,20	heavy loam
40-60	3,19	16,01	18,48	12,32	9,84	18,16	40,32	medium loam

The experimental plots are located on old irrigated gray soils with deep-lying sand and pebble deposits and groundwater at a depth of 3 m or more. The Soil of the site are non-saline (Sujatha et. al., 2023).

According to scientists, it is possible to obtain the maximum corn grain yield only by maintaining the lower limit of soil moisture at the level of 70–75 % of the Lowest Moisture Capacity from germination to waxy ripeness of the grain. Reducing soil moisture to 60 % of the Lowest Moisture Capacity in any phase reduces grain yield. Particularly low yields occur when the pre-irrigation threshold of soil moisture decreases during the period from germination to flowering. (Ibrahim Mubarak and et al, 2020).

The inaccurate establishment of the moistened active layer leads to irrational use of irrigation water, a rise in groundwater levels, and a decrease in crop yields. Greater moistening of the active soil layer leads to water losses due to infiltration and deterioration of the ecological and reclamation state of the irrigated field. Insufficient soil moisture reduces irrigation intervals, increases the number of irrigations, increases the cost of crops, and reduces the productivity of agricultural products. Differential establishment of the depth of moisture by changing the calculated soil layer leads not only to an increase in the absolute value of the mass of roots but also to a more uniform distribution of them over individual horizons of the soil thickness, conservation of water resources and land reclamation conditions (Sembaeva et. al., 2021).

The nature of moisture exchange in the active soil layer during the growing season is determined by the development of the root system of crops and the soil moisture regime. With sufficient moisture, water is consumed primarily from the upper horizons, and as the soil dries out, its consumption begins from the underlying layers, in accordance with this, the upper layers of the soils are characterized by the most active moisture exchange, and under conditions of optimal irrigation, the main part of the seasonal moisture turnover occurs in them (Junaid Nawaz Chauhdary1 et. al., 2017).

The results of the analysis showed that the site, in terms of agro climatic and soil indicators, is quite typical for this zone and is suitable for research.

Irrigation at the crop cultivation site was carried out using the drip method, based on the condition of maintaining soil moisture at an optimal level, taking into account the prevailing climatic conditions during the growing season of plant development in relation to the main phases of plant development. Adjustments to irrigation rates and operating time of drip irrigation systems were provided, if necessary, based on soil moisture indicators and the productivity of the drip irrigation system. Accounting for water supplied to areas for growing fodder crops was carried out with devices installed on a drip irrigation system.

The water consumption of an agricultural field with optimal water supply to plants obeys the physical laws of evaporation. Water is consumed a large amount by the plant through transpiration, which is necessary not only for nutrition and development of the leaf surface but also for cooling the temperature of the ground part of the plant. By changing environmental conditions, applying mineral fertilizers, increasing air humidity, and decreasing temperature, you can significantly reduce water consumption by plants and vice versa (*Imanaliyev* et. al., 2022).

The total water consumption of the crop under study is the main indicator characterizing the water consumption to create a crop yield. The component values of total water consumption are soil moisture reserves, atmospheric precipitation during the growing season, irrigation norm, groundwater use coefficient, and infiltration coefficient. Groundwater in the experimental area lies at a depth of 3 m and does not take part in recharging the root layer.

In the formation of corn for grain total water consumption under drip irrigation, the participation of soil moisture reserves is low and in the experiment is 7 %. In the years under study, moisture consumption by crops was compensated by an average of 14 % due to precipitation. The distribution of atmospheric precipitation during the growing season of corn has a significant impact on the irrigation regime. Also, the irrigation regime significantly depends on the level of pre-irrigation soil moisture.

The largest share of moisture in the experiment was replenished by supplying irrigation water with watering. In the years under study, the share of irrigation water in the total moisture consumption by crops averaged 78–79 % over the years of research. Analyzing the water balance item, we can talk about a direct relationship between total water consumption and the formation of the irrigation regime, as well as the necessary operating parameters of the drip irrigation system to ensure the soil water regime within the specified soil moisture limits.

It has been established that the irrigation regime, which develops while maintaining soil moisture at the level of 85 % of the lowest moisture capacity, provides maximum yield at the highest irrigation rate. The corn grain yield with a biologically optimal irrigation regime of 85 % of the lowest moisture capacity and the application of foliar feeding over the years of research averaged 12.7 t/ha, with fluctuations over the years from 12.43 to 12.9 t/ha.

The technology for cultivating corn for grain under drip irrigation requires compliance with all agrotechnical methods for growing crops under the optimal irrigation regime established for this method of irrigation. Since the irrigation regime is one of the main types of work included in the technology of cultivating crops, the applied irrigation regime should, based on the productivity of the irrigation technique, establish the timing and norms of irrigation to ensure optimal values of soil moisture and moisture depth.

Plant characteristics important for irrigation management include water consumption during the growing season, daily water consumption, plant growth rates by plant development phases, and root system depth. Essential soil characteristics are moisture capacity, degree of moisture, and the presence of soil horizons that prevent root penetration or water seepage. The main purpose of irrigation management is to provide additional water required by plants and to make optimal use of water.

Conclusion

The cultivation of corn for grain with drip irrigation is today the most innovative and most promising technology in crop production. An increase in yield by 1.5–2 times, technological effectiveness of production, and the possibility of extending the sowing period — all this leads to an increase in the area of its application at a rapid pace.

All known varieties of corn use water economically, which is associated not only with a reduced transpiration coefficient but also with the increased responsiveness of

corn to irrigation and its productivity. Corn typically produces high organic matter yields. Although corn uses moisture sparingly, the total amount of water consumed by the crop is quite large. During the growing season, corn, according to data, consumes a lot of moisture.

Drip irrigation technology taking into account provides optimal water supply to plants and nutrition, the phases of plant development. It should be noted that corn grows very slowly in the first month after germination and absorbs a limited amount of nutrients the lack of available nutrients during this period, especially phosphorus, negatively affects the further development of plants and reduces the use of nutrients from the main fertilizer and soil.

The development of water-saving drip irrigation technology is aimed at agrotechnical methods at establishing cultivating corn for grain and its irrigation regimes that would ensure high crop yields, subject to minimizing unproductive losses of irrigation water from the design soil layer and maintaining the reclamation state of the agricultural field.

REFERENCES

Data from the National Hydro meteorological Service of the Republic of Kazakhstan *https://www.kazhydromet.kz/ru/klimat/klimat-kazahstana-po-oblastyam*

Ibrahim Mubarak, Mussaddak Janat. Sweet corn crop response to different dripline spacings in the dry Mediterranean area//*Vol. 116 №. 1 -2020*/Agronomy section - 116/1. Pp. 125–136.

https://doi.org/10.14720/aas.2020.116.1.1382

Ibrayev T., Li M., Bakbergenov N., Narbayev M., Batyrbayeva A. (2022). Current issues of water management in Kazakhstan/News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences, 2022 (5). Pp. 79–92.

Ibrayev T., Li M., Bakbergenov N., Panenka P., Batyrbayeva A. (2022). Problems of the use of water resources and the ways of their solution in Kazakhstan/News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences, 2022 (4). Pp. 69–80.

Imanaliyev T., *Koybakov S.*, *Karlykhanov O.*, *Amanbayeva B.*, *Bakiyev M.* (2022). Prospects for the development of water resources management in the South of Kazakhstan. News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences, 2022. 6(456). Pp. 80–95.

Junaid Nawaz Chauhdary, Allah Bakhsh, Muhammad Arshad, Muhammad Maqsood. (2017). Effect of different irrigation and fertigation strategies on corn production under drip irrigation Pak. J. Agri. Sci. Vol. 54(4), 855–863; 2017. ISSN (Print) 0552–9034, ISSN (Online) 2076–0906. DOI: 10.21162/PAKJAS/17.5726. *http://www.pakjas.com.pk*

Mahdi Gheysari, Sayed-Hossein Sadeghi, Henry W. Loescher, Samia Amiri, Mohammad Javad Zareian, Mohammad M. Majidi, Parvaneh Asgarinia, Jose O. Payero. (2017). Comparison of deficit irrigation management strategies on root, plant growth and biomass productivity of silage maize//*Agricultural Water Management*. *Volume 182*. 1 March 2017. Pp. 126–138. *https://www.sciencedirect.com/science/article/abs/pii/S0378377416305121*

Mirdadayev M., *Basmanov A.*, *Balgabayev N.*, *Amanbayeva B.*, *Duisenkhan A.* (2022). Research of hydrogeological conditions and energy parameters of zonal irrigated soils when optimizing energy-efficient reclamation technologies in the republic of Kazakhstan. *News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences*, 2022 (5). Pp. 128–142.

On approval of the Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to the "Green Economy" for 2021–2030 Resolution of the Government of the Republic of Kazakhstan dated July 29, 2020 № 479 *https://adilet.zan.kz/rus/docs/P2000000479*.

Ospanbaev Zh., Sembaeva A., Doszhanova A. & Bagzhan A. (2021). Corn yield under drip irrigation. Izdenister Natigeler, (4 (92), 78–86. *https://doi.org/10.37884/4-2021/09.*

Salah E., El-Hendawy, Essam A. Abd El-Lattief, Mohamed S. Ahmed, Urs Schmidhalter. — Salah E., El-Hendawy, Essam A. Abd El-Lattief, Mohamed S. Ahmed, Urs Schmidhalter. Irrigation rate and plant density effects on yield and water use efficiency of drip-irrigated corn.-//*Agricultural Water Management Volume 95, Issue 7*, July 2008, Pages 836-844

https://www.sciencedirect.com/science/article/abs/pii/S0378377408000553

Sembaeva A.S., Omarova A.Sh., Ospanbaev Zh., Zhapaev R.K., Omarova A.A. (2021). Features of the technology for cultivating corn hybrids for grain in the conditions of the south-east of Kazakhstan// International scientific and theoretical conference "Resource-saving technology for cultivating crops - agriculture of the future", dedicated to the 70 th anniversary of the birth of Doctor of Agricultural Sciences, Professor, Academician of the Academy of Agricultural Sciences RK Sydyk D.A. 2021.- Pp. 313–317.

Sujatha H T, Angadi S S, Yenagi B S, Raj pal Meena. (2023). Effect of drip irrigation regimes on growth, yield and economics of maize (Zea mays) genotypes -//February 2023 - Indian Journal of Agricultural Sciences 93 (2): 163–168. *https://doi.org/10.56093/ijas.v93i2.132048*

Yang Liu, Hai-shun Yang, Jiu-sheng Li, Yan-feng Li, Hai-jun Yan. (2018). Estimation of irrigation requirements for drip-irrigated maize in a sub-humid climate//*Journal of Integrative Agriculture*. *Volume 17. Issue 3*. March 2018. Pp. 677–692. *https://www.sciencedirect.com/science/article/pii/S2095311917618331*

Zhaparkulova E.D., *Amanbayeva B.Sh.*, *Dzhaisambekova R.A.*, *Mirdadayev M.S.*, *Mosiej J.* (2021). Geological structure of soils and methods of water resources management of the Asa river. News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences, 2021, 4(448). Pp. 130–137.

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