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Prospects for the use of renewable energy and energy-efficient technologies in research areas

[1]Khakimov Oktam Tashbotirovich, [1]Turobova Sadokat Orif kizi, [1]Babaeva Zarifakhon Aktam kizi, [1]Adilov Sobitjon Uktamovich, [2]Kulmamatov Bunyod Bekpolat Ugli
Navoi Department of the Academy of Sciences,Uzbekistan
E-mail: turobovasadoqat1108@mail.com
Navoi State Pedagogical Institute, Uzbekistan
E-mail: bunyodbekpo'latovich16@mail.com

ABSTRACT
This article briefly describes the research carried out on the introduction, application and commercialization of renewable energy, energy-saving and water-saving technologies in agriculture in the research area of the Navoi Department of the Academy of Sciences.
Keywords. *Land, degradation, , suspension, innovative technology, seed encapsulation, rainfed agriculture, resource saving, bentonite clay powder, stimulant, fungicide.*

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INTRODUCTION

Agriculture is the main consumer of available water resources. Most of the agricultural products are grown through simple irrigated farming. In today's water shortage, it is important to use technologies designed to save water and improve the quality of irrigation, to use modern technologies that ensure even irrigation of crops along the edge and reduce irrigation water leakage.

In developed foreign countries, water-saving and mechanized and automated irrigation methods are mainly used for irrigation of crops by rain, drip and underground pipes. In the USA, Israel, England, Germany, France, Australia and a number of other countries, sprinkler and drip irrigation is now widely used [5].

4.3 million in our republic. hectares of irrigated agricultural land, of which water-saving technologies have been introduced in 291.2 thousand hectares. 120,500 hectares of them use drip irrigation, 3,500 hectares of sprinkler irrigation and 4,200 hectares of discrete (step by step along the slope) irrigation technologies. 163 thousand hectares of land is irrigated through flexible pipes.

According to the decision of the head of our state "On measures to accelerate the introduction of water-saving technologies in agriculture", in 2021 water-saving technologies increased 5 times to 430 thousand hectares [4].

The situation related to water shortage in our province is getting more complicated year by year. For example, in the last 10 years, the volume of water in Uzbekistan has decreased by 12% compared to previous years, and this year by 15%. Electricity and water supply costs are high for growing cotton and grain. In particular, more than 5,000 pumps are used to irrigate 2.5 million hectares per year, 8 billion kilowatt hours of energy and 2.4 trillion soums of budget funds are spent. An average of 800,000 soums is spent from the budget to supply one hectare of land with water through pumps. As a result of irrigation, almost 5-6 billion cubic meters or 20 percent of water is wasted in the fields. In such conditions, water conservation and management has become a more difficult issue than usual [1]

Contracts for 12 thousand 421 hectares of land and credit agreements for 10 thousand 759 hectares of land have been signed so far in the region for the introduction of drip and sprinkler irrigation technology for 2022. In particular, these indicators are 700 hectares in Karmana district, 2780 hectares in Qiziltepa, 4450 hectares in Navbahar, 2829 hectares in Khatirchi [2].

MATERIAL AND METHODS

In order to use water-saving technologies in the cultivation of agricultural products and grow agricultural crops in dry lands based on new innovative agrotechnology, scientists of the Navoi Department of the Academy of Sciences have started research in the research field in "Koktepa" region of Nurota district since February 2021.

At first, 20 hectares of land were planted with desert fodder crops. Lalmi grain was planted on an area of 56 hectares, local variety of chickpea was planted on an area of 12 hectares.

RESULTS AND DISCUSSION

Scientists of the Navoi Department of the Academy of Sciences of the Republic of Uzbekistan have developed two innovative water-saving technologies for the use of bentonite in agriculture. These developments have shown their effectiveness in field tests. Taking this into account, the Navoi department is taking a new approach to the commercialization of scientific developments.

The sorption properties of bentonite, that is, the ability to absorb and retain moisture, ensure stress-free germination of seeds and their stable growth, covering the water needs of plants. In the past years, the use of these developments made it possible to obtain an additional cotton yield of up to 15% on average, and an additional yield of up to 31.6% per hectare when tested on the "Durdona" wheat variety. In addition, in 2022, the Navoi department introduced its innovative water-saving technologies, and on 10 hectares of non-irrigated dry land of the Nurota district "Umrbek" farm, 16.0 centners of wheat were harvested per hectare (6.8 t/ha in the control area), that is, the yield is almost 2.5 doubled.

The high yield of crops gave scientists confidence in the effectiveness of their development, and it was decided to create an initiative group to organize wheat cultivation in non-irrigated drylands using innovative technologies developed by the department. Scientific employees of the department entered the initiative group on the basis of a share with their personal funds. An agreement was made between the members of the initiative group and the Navoi department, according to which the financial costs of the project will be covered by the members of the initiative group, while the Navoi department will allocate land for temporary use and provide technology. The profit from the sale of the finished product is distributed according to the share of the participants. Also, part of the funds will be transferred to the fund being established in the Navoi department, and a valuable seed fund will be established.

The close integration of science and practice, as well as the mutual cooperation of the initiative group, opens up new opportunities for the commercialization of scientific developments, thereby allowing scientists to earn additional income.

In addition, it allows to contribute to the solution of food security, and most importantly, to carry out scientific research aimed at studying the effects of the proposed technologies and preparations on the growth and development of plants.

A decision was made by the initiative group to plant wheat on 56 hectares of dry land belonging to the "Qiziltepa" scientific-research experimental station established under the department. Doctoral students of the related field were involved in the implementation of the project, and an opportunity was created for them to study this technology theoretically and practically.

Our scientists signed a memorandum of cooperation with the Institute of Genetics and Plant Experimental Biology. Under contract, this institute supplied the seeds of new varieties of soft wheat "E'zoz" and "Qayroqtosh" which can be grown in dry conditions created by ITI scientists. Also, the Academy of Sciences sent the stimulant "AA-01" developed by scientists of the Institute of General and Inorganic Chemistry for testing. According to the developers of this drug, it has a wide range of stimulating and fungicidal effects. In particular, it helps the growth of plants and increases productivity.

Figure 1. General view of the grain field

The experimental area is divided into several plots, two of which use innovative water-saving technologies developed by the department, namely, coating wheat seeds with bentonite clay powder and feeding plants with foliar fertilizers. In the other two plots, the process of suspension feeding is carried out with UNKI's "AA-01" preparation individually and with the addition of bentonite. The fifth section was designated as a control area. For scientific observations, a train station with all amenities was created and equipped with renewable energy devices.

Figure 2. The process of shelling and planting grain seeds with bentonite powder

The seeds planted in the experimental area in February this year were covered with bentonite clay powder. In this case, the sorption properties of bentonite, that is, the ability to absorb and retain moisture, ensured the safe germination of seeds and their stable growth, partially covered the water needs of plants.

Wheat variety "Surkhak 5688" was planted on 50 hectares of the experimental area, and two new varieties of soft wheat "E'zoz" and "Qayroqtosh" that can grow in dry conditions created by scientists of the Institute of Genetics and Experimental Plant Biology of the Academy of Sciences were planted on 6 hectares. Grains in the experimental field were fed 2 times per hectare with 3 kg of bentonite clay powder and 7 kg of urea fertilizer suspension and 1 time with "Hectar" drug. The effectiveness of the technologies used in wheat fields maintained on the basis of innovative water-saving technologies was studied.

In addition, due to the presence of the thrips pest on the wheat, the grains were treated with the drug "Karate" against pests.

Figure 3. Today's state of the grain ears in the experimental field.

Table 1: The results of the experiment carried out on varieties of dry wheat Surkhak-5688, E'zoz, Qayroqtosh and planted for control.

Wheat variety	The time taken for germination, day	Length after 10 days, cm 08.03.2023.	Length after 30 days, cm 28.03.2023.	Length after 60 days, cm 27.04.2023.	Length after 75 days, cm 08.05.2023	Today's situation
Surkhak-5688	3	6	28	37	45	The stem is strong, well packed
E'zoz	4	5	25	36	46	The stem is medium, strong, well packed
Qayroqtosh	3	6	30	41	47	The stem is strong, well packed, the root is strong
Control	6	4	23	33	42	The stem is medium, strong, well packed

As can be seen from this table, the Qayroqtosh variety of dry wheat is distinguished from other grain varieties by its quick germination, strong stem, fast growth, well-developed root system, and good flowering. The technology of shelling the stone variety with bentonite powder served to further improve these parameters of the plant. We can easily use this variety in our next experiments and recommend its planting to other farmers in the region.

In order to efficiently use the land around the wheat field, to protect the field and to increase the medicinal plants, the seedlings were planted along the field. The main goal of this is to use the land rationally, to expand the area of medicinal plants, and to carry out practical experiments on the cultivation of medicinal plants in dry lands.

Use of renewable energy sources

Humanity has been using energy accumulated by nature for thousands of years. The methods of using this energy are constantly being improved in order to obtain maximum efficiency from it. Energy plays an important role in human life. All types of human activity are closely related to energy consumption [4].

The Navoi Department of the Academy of Sciences of the Republic of Uzbekistan plans to introduce a heating system using renewable energy sources in greenhouses and experimental sites. The parabolacentric concentrator, designed for heating a 250-300 cubic meter greenhouse, developed by the Institute of Materials Science of the NPO "Physics-Sun" of the Academy of Sciences of the Republic of Uzbekistan, is being tested in the department's greenhouse.

An important factor in conducting field trials is the establishment of specialized agricultural laboratory research in the department using renewable energy sources under field conditions. Important indicators of soil and water, such as chemical and mechanical composition, salinity, moisture capacity, pN, as well as physical properties, can be quickly determined.

After the installation of the solar radiation system in the greenhouse with a 0.1 kilowatt photoelectric power plant, it is planned to start experimental work: testing the germination of seeds of cotton, wheat, peas, selected varieties of vegetables, field crops for scientific research, and desert-pasture fodder crops. It will be possible to observe the effect of bentonite clay powder on seed germination and development, to evaluate the effectiveness of bentonite suspensions in different proportions on the growth and formation of plants, and to conduct various other studies.

At the moment, seeds of cucumbers, tomatoes, greens covered with bentonite clay powder are being planted in the mini-greenhouse. During the growing season, plants feed on leaves.

As a result of these studies, it can be concluded that the application of technology of shelling of grain seeds and suspension of leaves with bentonite in the optimal options recommended above is very effective.

As a result of these studies, the following recommendations can be made: 1. It is advisable to plant dry grain in autumn in October-November.

2. The grain planting area should be plowed at a depth of 30 cm, evenly, with good quality, with 100-150 kg of ammophos fertilizer under the plow.

3. For Nurota district, it is recommended to plant "Surkhak-5688" variety with 100-110 kg of bentonite powder per hectare.

4. A high yield can be obtained from grain by foliar feeding with carbamide fertilizer and bentonite powder 4 times during the growing season in the above rates and by conducting appropriate preventive measures against various grain pests.

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