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USE OF GIS TECHNOLOGIES IN PLANT PEST AND DISEASE CONTROL SYSTEM

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monograph

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E.R. Sobirov, Q.B. Razzoqov, I.I. Abdullayev, R.A. Eshchanov, R.S. Ro‘zmetov

Monograph "Use of GIS technologies in the system of combating plant pests and diseases".

The monograph is recommended for use in practical training as a study guide for master's students, doctoral students, specialists, farm managers and students of agronomy, soil science.

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Contents

LIST OF TERMS AND TERMS

Ce.	centner
T	tons
He	A hectare
^0C	Celsius temperature
T	Temperature
FAO	Food and agroculture Organization under the United Nations
Γ	Gram
m/sek	meter/second
fungicide	A pesticide used against fungal diseases
GPS	Global Positioning System.
GIS	geographic information system.
Lansat	the name of a satellite of the earth
NDVI	Normalized difference vegetation index
R-studio	Software for mathematical analysis of geographic data
Modis	the name of a satellite of the earth
AcrGIS	a computer program designed to analyze geographic data
SEF UNESCO	Science Development Center under UNESCO
UN	United Nations

INTRODUCTION

Concepts for reforming the country's political, economic and social life, including agriculture, were developed by the President of our Republic. From the early days of independence, ensuring food security was set as a priority, and above all, deep reforms were implemented in agriculture. In order to implement the tasks defined in the Decree of the President of the Republic of Uzbekistan No. PF-4947 of February 7, 2017 "On the Strategy of Actions for the Further Development of the Republic of Uzbekistan" as well as in other regulatory and legal documents related to this activity, it is necessary to grow more fertile crops from agricultural crops and make the population ecological it is required to provide clean food products.

According to experts in the field, in 1991, 1908.2 thousand tons of grain crops were produced in the country, and this indicator reached 3562.0 thousand tons in 1996 and 6703.1 thousand tons in 2011, which increased by 186.6% in 1996 compared to 1991 and In 2011, this figure was 351.2%. The production of other main agricultural products in the country also increased compared to 1991, potato cultivation by 530.2%, vegetables by 208.8%, fruit by 362.1%, grapes by 226.95%, and sugarcane cultivation by 139.8%. increased. Uzbekistan is located in a favorable place for farming in terms of natural climate and soil conditions. It has more than 3,000 hours of annual sunshine, which makes it possible to harvest 3 times a ear. 1.4 million in Uzbekistan. tons of cotton fibers are produced, about 4 million tons of grain, 5 million tons tons of sweet-sugar fruits and vegetables, many cocoons, black lake skins and other products are grown. Uzbekistan is spreading its fame to the world with its cotton, black leather, cocoons, silk, and grape products. Now it is the fifth place in the world in terms of cotton cultivation (China, USA, India, Pakistan), and the second place in terms of cotton fiber export. Leaders, farmers and specialists in this field have made great contributions to the success achieved. As a result of bringing the plant protection system to new heights, progress was also made in protecting the cultivated and harvested crops from harmful organisms. However, there are still big tasks ahead of the industry workers.

According to the United Nations Food and Agriculture Organization (FAO), 20-25% of the total crop is destroyed by pests and diseases of agricultural crops every ear. That is why plant protection is of great importance in increasing the productivity of agricultural crops. In agriculture, including the protection of plants from pests and diseases, the use of modern information and GIS (geoinformation system) technologies remains the need of the hour.

GAT technology has begun to find its place in the field of agriculture and plant protection. In the developed countries of the world, great efforts are being made to predict the development of harmful organisms based on GAT technology, and to create a system to combat them. In addition to the above information, it can be noted that by the beginning of the 21st century, improved GAT technologies were created to fight against pests that cause great damage to agricultural crops.

In Uzbekistan, practical and research work on GAT technology in the field of plant protection has been started. It is worth noting that among the first practical works in this field, the German GTS organization provided the employees of the anti-locust service in Karakalpakstan with a GPS-navigator, and they are working using the GPS-navigator to determine the areas where locusts are spread. In the following ears, work is being carried out on the application of GAT technology to control the population of harmful locusts.

Coordination of science and technology development under the Cabinet of Ministers of the Republic of Uzbekistan in cooperation with scientists of Khorezm Ma'mun Academy, Urganch State University, Institute of Zoology of the Academy of Sciences of the Republic of Uzbekistan, National University of Uzbekistan, Scientific Research Institute of Plant Protection of Uzbekistan In accordance with the contract ITD-9-48 of the Committee (Ministry of Innovative Development of the Republic of Uzbekistan) during 2012-2014, within the framework of the topic "Development of a modern system of environmental monitoring and early detection and management of pest insects" Scientific research was carried out on the results of the research on the implementation of control measures based on GAT. This brochure was prepared based on the results of the research.

Also, the decision of the President of the Republic of Uzbekistan dated March 20, 2013 No. PQ-1940 "On the Program for the Development of Tourism in the Khorezm Region in 2013-2015" and the Decree of the Cabinet of Ministers of the Republic of Uzbekistan dated February 2, 2012 No. 27 "On Termites in the Republic the decision of the President of the Republic of Uzbekistan "On the acceleration of countermeasures and elimination of their damage" and the Decree of the President of the Republic of Uzbekistan dated August 30, 2019 "On the development of space activities in the Republic of Uzbekistan" PF-5806 and December 29, 2015 Decision No. PQ-2460 "On measures for the further reform and development of agriculture in 2016-2020", the state program "2020 - the ear of development of science, enlightenment and digital economy" and other This dissertation research serves to a certain extent the implementation of the tasks defined in public documents.

STATUS AND PROSPECTS OF USE OF GEOGRAPHIC INFORMATION TECHNOLOGIES IN THE FIELD OF PLANT PROTECTION (literature review)

§ 1.1. The use of geographic information technologies in the study of the development of harmful arthropods.

Today, great attention is being paid to the research of locusts, which are one of the most dangerous pests of crops in the world, using modern methods. In 2000, against harmful locusts, 10 million were spent in Russia and Kazakhstan. hectare, in particular, 8 million hectares in Kazakhstan, 2 million hectares in Russia, although historical scientific sources indicate that in 1989, 1990, 1999, 4 million hectares were combated in 70 ears. it is noted that it was carried out [37; pp. 44–47, 47; pp. 24–28].

In 2011, in 10 countries of the Caucasus and Central Asia, the fight against harmful locusts was carried out on an area of 4.4 million hectares [24; pp. 13–15]. Annually in the USA, on average, 20-25% of agricultural crops are destroyed by harmful locusts, and 1 billion dollars are spent on the control of these pests. Also, in West African countries, in 2003-2005, the desert locust Schistocerca gregaria (Forsk) caused damage to agricultural crops planted by 8 million farmers and residents, which significantly affected the agricultural economy. [38; pp. 16–17, 39; pp. 10–11].

In recent ears, a number of countries have been creating pest control monitoring systems based on GIS technologies and MZ (remote sensing) data. In 2010, as a result of providing its branches with new modern equipment, the "Rosselhozcentr" center of the Russian Federation created a database for harmful organisms distributed on the territory of the country and developed maps of their distribution [179].

In the Republic of Kazakhstan, a system of combating locusts based on MZ and GIS technology was created. Methods for determining the population and status of locusts have been developed in the United States based on satellite data and geodata materials. In Kazakhstan, the information system for combating locusts has been implemented in 14 regions and was created on the basis of the funds of the Asian Development Bank (ADB) project. Also, within the framework of the Agroatlas international project in the Russian state, it covered information about plants and their pest organisms distributed on the territory of Russia [6; pp. 20, 53; p. 17].

The system "Agroekologicheskiy atlas Rossii i sopredelnyx stran: ekonomicheski znachimye rasteniya, ix bolseni, vrediteli i sornye rasteniya" was developed [181]. This resource combines maps representing more than 100 types of agricultural crops, more than 560 types of their wild ancestors, 640 harmful organisms that damage them, and 200 external factors. If it is used, it is possible to predict the development of plant pests, determine control measures and carry out measures in a timely manner.

A number of pages on the Internet contain information about the system of plant protection based on GIS technologies and the activities carried out. In particular, the website [176, 180] http://rsc05.ru/-zemledelie.html provides information on locust control using GIS technology.

The development of GIS technologies began in the 1960s in the universities of the USA, Canada, England, and Russia. The work of the US Census Bureau was of great importance in the development of GIS technology. The GBF-DIME format created by the Census Bureau was designed to collect topological information. In the 1970s, a commercial GIS company, ESRI, was established and made significant contributions to the development of GIS technology. Later, this system rapidly developed in promising sectors of the national economy and in the military sector. By the 90s of the last century, GIS technology began to develop in the field of science and technology and in almost all directions [75; p. 1340].

GIS technology has begun to find its place in the field of agriculture and plant protection. In the developed countries of the world, great efforts are being made to use GIS technology to predict the development of harmful organisms and to create a system of combating them. In addition to the information given above, it can be noted that by the beginning of the 21st century, improved GIS technologies were created to control pests that cause great damage to agricultural crops. For example, FAO applied GIS technology in several African countries to combat the desert locust (Schistocerca gregaria Forsk.) [76; p. 383].

GIS technologies have been created throughout the federal districts of the Russian Federation, which identify wintering reserves of harmful organisms. According to the essence of this system, the collected data is divided into two sources. Data collection of field sources is carried out using a GPS navigator. The collected data is entered into a computer program and used in the form of a table or chart or in the form of a map. A map showing the amount of winter stock of very dangerous pests in the North Caucasus Federal District of Russia in 2012 was compiled. [10; p. 21]

The map data shows the overwintering areas and abundance of pests such as rodents, grasshoppers, Colorado beetles, weevils, and meadow moths. Based on this information, comprehensive pest forecasting and control measures are developed. This makes it possible to fully control the development of pests and prevent the damage they cause. A number of works of foreign scientists on the use of GIS technologies in the development of measures to combat the spread of harmful locusts are known [72; pp. 517–526]. Also, on the Internet pages [175, [174, 175, 177, 178], information is provided on the use of GIS technologies for plant protection. In Kazakhstan, a system was created to monitor the control of locusts and their development (Казакҳстанская информатсионная система по борбе с вреднйми саранчовйми - КИСБС). The British Natural Resources Institute, in collaboration with the University of Edinburgh, created the RAMSES system to control the desert locust population [23; pp. 22-23].

The problem of protecting plants from harmful organisms is one of the important problems of state importance. At the same time, on the one hand, there is objective information about the condition of pests, diseases and weeds of agricultural crops, and on the other hand, the possibility of implementing protective measures without the environment and its changing tendencies. [172; pp. 45-50]. Therefore, it is necessary to create an ecological monitoring system of the development, spread and damage of agricultural crops and harmful organisms of the environment. From a scientific and organizational point of view, this issue is very complex and requires the involvement of specialists from various fields of knowledge [12; p. 200]. Due to the fact that the natural conditions of our republic are very favorable for the mass reproduction of insects, including insects that are harmful to agricultural crops, they develop forcefully and cause great economic damage. Currently, more than 100 types of insects are known as the most dangerous pests. Among them are harmful locusts, harmful beetles, beetles, aphids, thrips and other species, which seasonally cause great damage to grain crops, technical crops, rice and vegetable crops, and garden and forest trees [34; pp. 66-61, 162; p. 352, 163; p. 409, 167; p. 99, 169; p. 442, 170; p. 354]. In particular, 8-10 billion per ear from the state budget only for the fight against locusts. funds in the amount of soums will be spent [p. 21; 18].

In Uzbekistan, harmful locusts are considered an insect that causes great damage to agricultural crops. Among the locusts that cause major damage to agricultural crops in Uzbekistan are Moroccan (Dociostaurus maroccanus Thunb.), oasis (Calliptamus italicus L.), Asian (Locusta migrotoria L.) locusts and Dociostaurus kraussi Ingen., Ramburiella turcomana F.-W., such types are widespread [152; p. 18, 153; p. 76]. Out of 41 locust species identified in Karakalpakstan, Locusta migrotoria L., Calliptamus italicus L., C. barbarus Costa, Thrinchus campanulatus F.d.W., Tetrix tartara I.Bol., Heteractis adspersus Redt. and other species are the main pest locusts [53; p. 56].

In the conditions of Uzbekistan, the total reproduction of this species of grasshoppers is observed every 8-12 ears. In 1986-2000, the Moroccan locust, in 2000-2001 and 2012-2013, due to the increase in the overall development of the Asian locust, a large amount of state budget expenses were spent to fight against them [110; pp. 167-173]. In order to eliminate the consequences of the gross reproduction of the Asian locust, the special statement No. 217 of the Cabinet of Ministers of 2012 (October 12, 2012) was adopted. The largest distribution center of the Moroccan locust is located in Uzbekistan. we can also see on . In 1901, the Moroccan locust damaged 41,000 hectares of agricultural crops in this area, especially cotton fields, and the value of that period was 1 million. information about the damage of soums. The Moroccan locust is an omnivorous pest and damages almost all agricultural crops. This insect has been found to multiply in 25 countries of the world [156; p. 448, 158; pp. 58-59].

Locusts that live alone, Turan, Desert Prussians and other species are considered to be the most damaging locusts. For example, in 1984, in the Qamashi district of the Kashkadarya region, grasshoppers multiplied and damaged more than 1000 hectares of grain fields [52; p. 22]. Research on the study of harmful locusts has been carried out in separate regions of our republic and neighboring countries. G.Sh. Shamuratov, L.M. Kopanevalar carried out special studies on the study of Asian locust nests in the Amudarya delta of the Republic of Karakalpakstan [165; pp. 125-130, 169; p. 442].

M.V. Stolyarov studied the species composition of the Amudarya sheep and showed some characteristics of their distribution. In addition to studying the bioecological characteristics and systematic status of harmful locusts, a number of works have been carried out to determine the criteria for causing harm, to develop and improve control measures. In the conditions of Uzbekistan, if there are 8-10 swarms of locusts per 1m2 of agricultural crops, they reduce productivity by 3-5% [21; p. 23, 22; p. 35].

In Uzbekistan, research work on GIS technology in the field of plant protection has hardly been carried out. The German GTS organization provided GPS-navigators to the anti-locust service workers in Karakalpakstan, and they partially mastered the possibilities of using the GPS-navigator to determine the areas where locusts are spread. In the following ears, within the framework of the project "Пятилетная Программий, направленной на улучшение натсионалной и регионалной борбй с саранчовйми на Кавказе и в Сентралной Азии (КСА)", work is being carried out on the application of GIS technology to control the population of harmful locusts in Uzbekistan. [110; pp. 167–173, 89; pp. 66–68].

1.2-§. Possibilities of using geographic information technologies in the protection of agricultural crops from pests.

It causes an average 33.7% decrease in crop yields around the world. 12% of them are caused by diseases, 12% by insects, and 10% by weeds. In the United States, there are estimates of $7.7 billion in annual damage caused by insects of $9.1 billion. In the fight against the cotton bollworm, it is necessary to study its damage criteria in the field. It was observed that the error is high when the number of eggs is taken as a basis. Because many young larvae that have hatched from the eggs die, their number decreases [78; p. 135]. Adult butterflies mostly fly out at night and lay eggs in mating [97; pp. 130-132].

In India, the number of cotton bollworm eggs has been found to increase with increasing humidity in the fields of cotton, tomatoes and other crops. When atmospheric air is 65%, their number increases dramatically [84; pp. 137-142, 85; pp. 462-466].

Female butterflies lay an average of 1400 eggs in laboratory conditions [86; pp. 6-10]. The cotton bollworm lays a certain number of eggs on each plant organ without placing them all together in field conditions. As soon as it gets dark, the majority of female butterflies fly out and start laying eggs, and the number of egg-layers decreases towards morning [90; pp. 1–7, 137; pp. 67–69]. The cotton bollworm lays many eggs on the young leaves of cotton. This period often coincides with the period of cotton formation of generative organs [120; pp. 483-490]. There is no significant difference between the number of eggs laid by the cotton boll weevil and the plant plots where it laid its eggs [83; pp. 402–432]. Larvae enter the soil after 15-18 days and begin to pupate, and the period of pupation lasts 11-14 days [91; pp. 569-575]. Larvae experience 5 ears of development. According to their age, the transition period of each age is 3.5; 2.5; 2.1; Lasts 2.7 and 2.5 days. The distribution of H. armigera in cotton fields may develop depending on the density and condition of the crop during the fruiting period [48; pp. 50-53], [49; p. 50]. Larvae are mostly found in the upper layer of cotton. Young larvae are 90% more common in the young leaves of the tips of the cotton compared to the general young larvae. When they reach adulthood, they have to cover a certain distance over time [92; p. 45, 96; pp. 46-48]. The decrease in the number of bollworms in the field under the influence of parasites can vary from 0-50%. [87; pp. 65-66]. In Australia, critical humidity is a determinant of outdoor tolerance for H. armigera, H. punctigera. H. armigera has the ability to quickly adapt to any insecticide [126; p. 117-125]. To apply chemical methods, it is necessary to have 5 larvae under 3 ears old and more than 12 eggs in 24 plants [135; pp. 9-20].

Climate change is observed as a result of human influence on nature. This is caused by the increase in the amount of carbon dioxide, methane in the air, which increased to 0.850 in the next 130 ears, and in the short term, this indicator is observed to change to 1.5-4.80 C [122; pp. 3362–3374, 123; pp. 429–436]. Living organisms, exotherms, including insects, can develop and reproduce within the limits of temperature changes in small ranges. [102; pp. 863–876, 109; pp. 8335–8342]. Increasing these changes at certain times can cause strong physiological changes in organisms and lead to death [129; pp. 149–160]. Factors affecting cotton borer under field conditions include plant condition, irrigation conditions, soil moisture, temperature and soil structure, parasitism, predation, and frost. [135; pp. 9-20, 106; pp. 49–58, 98; pp. 17–28]. Adaptation to each of these factors creates an opportunity to expand the distribution area of the cotton bollworm. Climate change can occur on different timescales and scales. This also causes the death of the stomach worm. In addition, the dry climate reduces the number of parasites that damage the cotton plant. Cotton can be a limiting factor for growth [105; pp. 449–460, 108; pp. 6-9].

In addition, it strongly affects the competition between annual and perennial plants [111; pp. 119–125]. The study of climate change is considered one of the sources that allows to estimate the width of the distribution area of the cotton bollard, their density, demographic dynamics and their migration [127; pp. 243–246]. It is possible to predict the distribution and density of insects by predetermining climate indicators [137; pp. 439–444, 148; p. 192]. Widespread use of pesticides in Australia and other foreign countries has led to the emergence of new problems in the fight against the cotton bollworm. This is due to the strong adaptability of the cotton boll to pesticides. [97; pp. 130–132, 154; pp. 44–46]. In 1989, H. armigera caused a loss of 25 million US dollars to 225.2 million US dollars, and 817.9 million US dollars were spent to fight against it [115; pp. 367–371, 111; pp. 119–125].

In the experiments conducted in Slovakia, the temperature at which cotton buds start to wake up is 11.50, and the sum of the effective temperatures for giving one generation is 6250. [77; pp. 135–138].

Diptera: Culicidae distribution in the irrigated fields of Poland and changes in their number and species composition depending on external environmental factors were created and analyzed on the basis of GIS technologies. [104; pp. 1–12]. Based on the temperature data base, the methods of predicting the areas where the cotton moth can fly were developed in the US state of Texas [113; pp. 46-49]. Models based on this base by American scientists showed that they increase when the temperature in a 10 cm layer is 230 C. In this case, he correctly correlated the indicators of environmental conditions [121; pp. 28–29].

In the same way, he developed methods for early detection of the appearance of adult worms. A number of researchers have studied the effect of precipitation on cotton buds. It has been studied that the amount of precipitation has an inverse correlation with the appearance of cottontail butterflies, and the reasons for this are given. A high amount of precipitation leads to the destruction of chambers of cones in the soil [112; pp. 1–9]. Excessive wetting of the soil during precipitation reduces the viability of the butterflies during the emergence of butterflies due to the destruction of their tracks emerging from the soil during the transformation into butterflies or they remain completely in the soil [107; pp. 140–147].

Female cottontails, H. zea, are more common in the first half of the night, and males are more common in the second half. Young larvae of H. armigera also feed on tomato seeds. Mainly, cottontails begin to feed on cocoons from the third age [90; p. 1–7], 87% of young larvae feed on leaves. 1, 2, 4, 6 larvae per plant 8.75; 18.50; 26.25; 3.00 per square meter of 33.00; 6.00; 9.50; 13.70 will damage the pores. 5 different degrees of damage in 1 plant 0; If 2, 6, 7, 8 pieces are infected and die after the end of their generation, the yield of cotton may remain unchanged. Because the plant can restore the damage in 10 weeks [85; pp. 462–466]. Damage to cotton depends on the leaf structure that produced it during the season. In the cotton fields of China, the cotton weevil produces 3-4 generations, the second generation is considered to be the most damaging. Generation 2-3-4, respectively, 1 square meter. 16.65, 11.83, 9.52 can damage the pod and reduce the yield [82; pp. 881–896, 131; pp. 87–92].

The species composition of common insects in India was determined and electronic maps of their distribution density were developed. The obtained data were comparatively analyzed on the basis of GIS software. It was shown that the distribution of insects depends on environmental factors [98; pp. 17–28].

There are devices and computer programs that remotely determine the degree of damage to crops by pests and their attraction to crops. A special database is needed to use these devices and computer programs for effective protection of plants [144; pp. 45–54, 143; 474– 487 p.]. By using GIS technologies, we can only chemically treat areas infested with pests. In this case, we will have the opportunity to save funds spent on preventing environmental pollution and protecting plants [83; pp. 402–432]. Entomologists have been interested in issues of insect ecology and plant protection. It is possible to archive, classify and associate them with images through GIS software. By applying GIS technologies, it is possible to connect insects with their distribution, migration, biology and other ecological environments in their breeding places. GIS technologies are considered to be one of the devices for predicting the potential of insect reproduction due to climate change [74; pp. 2512–2524]. In Russia, the sanitary condition of agricultural crops was assessed using the vegetation index (NDVI). Weeds and pests were analyzed. Based on the obtained results, the need to collect separate spectral data for each type of crop was shown. Although the development of agricultural crop pest organisms, reproduction patterns, and methods of their statistical analysis are increasing ear by ear, the world scientists have different methodological approaches to monitoring based on GIS technologies, but this issue has not been fully studied. This indicates the need to use and apply new scientific achievements in the field [54; pp. 3–11].

In tomato and cotton fields of India, the effect of effective temperature on cotton root rot was studied, and it was found that 94% correlation was given [121; pp. 28–29, 127; pp. 243–256].

A multifactorial analysis was carried out to study the dependence of the fields of cotton tundra in Iran on external environmental factors. Scientists have determined that their geographical distribution affects their morphological structure [107; pp. 140–147]. An algorithm for predicting the spread of insects was developed in Zarakundan [143; pp. 474–487].

Digital maps were developed based on mathematical models for the distribution of representatives of Hemiptera: Coccoida, Heminoptera: Formicidae [108; pp. 6–9].

A database was created based on the model algorithm based on aerial photographs of agricultural crops and forests. Prediction methods have been developed based on the database model algorithm [35; p. 62].

Research has been conducted to determine the age of trees using satellites. A model was developed based on the change in the size of tree branches. Tree age and height were estimated by satellite [26; pp. 245–246, 27; p. 272].

Coleoptera: Data on distribution and economic damage of Chrisomelidae pests in Dakota were collected and a module for analysis was developed based on GIS software [75; p. 1340].

The distribution of the borer and apple worm in diamond orchards was studied based on the sum of effective temperatures, and electronic digital maps of their distribution were developed. A model was created for the preparation and development of these maps [51; pp. 41–44].

The use of GIS technologies for the study of Helicoverpa sp has not been fully studied in the mountainous regions of the United States. Using light traps, H. zea was collected and maps of their distribution areas and densities were developed using GIS software. . The purpose of this is to have more information on the areas where H.zea is spread, and these maps were created every week [94; pp. 145–150]. Z. Lu and a number of researchers studied the methods of determining the areas where H. armigera appears in the Xinjiang region of China using GIS software by calculating the daily temperature [114; 582– 587 p.] Moral García used the information obtained from pheromones in Spanish tomato fields to develop maps representing the distribution patterns of H. armigera by obtaining the coordinates of pheromones [116; pp. 733–744, 117; pp. 253–259]. At that time, modern GIS technologies were not suitable for use in agricultural production to predict the distribution of H. armigera, H. punctigera, based on indicators of climate factors [125; pp. 151–156]. However, based on pheromone traps and radar data, methods for predicting the number of insects, distribution area, and migration of H. armigera and H. punctigera were used. This model includes 12-year data of average daily temperature, precipitation, soil landscapes (vegetation biomass) NDVI indicators [128; pp. 15–16].

Rochester incorporated NDVI data from NOAA, AYHRR satellites into its model, which has a high resolution radiometer. This model specializes in forecasting the night owl population by combining climate indicators. Polyphagous Helicoverpa spp. makes a great contribution to the appearance of sexually mature insects that have developed in the plant body. According to quality nutrition. can be classified as sexually mature. In this case, the food plant is classified as good or bad. In this case, it is defined by the number of eggs or larvae in the plants, and the number of healthy butterflies that can reproduce eggs and larvae means that the plant is quality food. Plants also respond based on external appearances depending on the number of eggs laid on them. In Australia, research was conducted on the prediction of the spread of H. puntingera based on vegetation cover and environmental factors. High temperature and drought have caused plants that this insect loves to not develop well. Chamomile, which this insect feeds on, began to decrease after rainfall in early spring [124; pp. 591–594, 125; pp. 151–156].

In Uzbekistan in 1955-1968, the factors indirectly influencing the increase of the cotton boll weevil, taking into account the specific characteristics of the area where the pest is spread, and applying the methods of combating them in practice based on deep ecological research. methods have been developed [71; p. 132].

Until the 1930s, characteristics such as the development of the cotton bollworm in different phases, nutrition, types of plants it feeds on, life form, level of harmfulness of larvae, and the effectiveness of toxic chemicals were described. After 1930, in field experiments, characteristics such as temperature, humidity, feeding during a long and bright day, parasites, predators that feed on them, pathogens, and pollination were studied. In Uzbekistan, cotton and other crops are severely damaged by the cotton bollworm. Heliothis armigera (Heliothis armigera Hb.) is widespread in temperate and subtropical regions of the globe. In Central Asia, cotton wool is found everywhere. However, its quantity and damage are different in different soil and climate zones. Most of the regions of Surkhandarya, Fergana and Andijan are constantly affected. After the commissioning of a number of irrigation facilities, this pest began to cause damage in the Bukhara region, in the southeastern zone of the Syrdarya region [15; 540 - p.]. The first generation of cotton bollworm is usually less harmful and develops in the following crops: peas, tobacco, flax, tomatoes and corn. It starts to lay eggs on cotton from the period of carding. In the first half of summer, the pest falls on early-developed plants, and in the second half on late crops. The laid eggs are gray in color and then brown. Butterflies lay their eggs mostly singly on the leaves near the growing points of the cotton stems, on the petioles, and on the bases of the bolls and flowers. At the same time, butterflies like cotton fields. Depending on the hygrothermal conditions, worms emerge from the eggs every 4-6 days. The worm hatched from the egg has a pale blue, almost clear discharge head, soon the head of the worm darkens, and the color of the body becomes even darker. The body of the worm is covered with small carpets. There is one sword in each of the rugs. During the six-year period, the color of the worm's body changes from brown - black or green to ellowish, depending on the age and which part of the plant it feeds on [148; p. 192].

Worms of the last age, which have been fed, fall into the soil, form a nest at a depth of 5-12 cm and turn into a mushroom. In rare cases, it burrows outside the nest in cobs or corn cobs. The color of the bulb changes from light pink-yellow to reddish-brown [151; p. 34]. A female cottontail can lay 400 to 2,000 eggs, depending on her health and supplemental nutrition. During the season, the cotton plant gives three to four generations, in which the development of each joint does not take place at the same time. At the beginning of the season, some stages of the first instar develop relatively long, in the middle of summer it accelerates under the influence of heat, and in August and September it slows down again when the temperature drops. In general, the cotton moth completes its full development period (generation) in 30-40 days until it turns from an egg into a butterfly. The cotton bug overwinters in the form of a mushroom in fields empty of cotton, corn, and tomatoes, as well as in paykal and uvats adjacent to them [157; pp. 41– 42].

The cotton bollworm is an omnivorous pest. It feeds on many wild and cultivated plants of various families. The most popular of these are cotton, corn, tomatoes, tobacco, many legumes, as well as pumpkins and peanuts, wild hemp, hemp, etc. The cotton bollworm can also damage roses, chrysanthemums, etc. from flowers [18; pp. 40-45].

Cotton dust that has fallen on cotton reduces the yield of cotton and lowers its quality. Young caterpillars eat the flesh of cotton leaves and feed on young shoots. Middle-aged worms eat pods and flowers, and older ones - nodules and pods. Damaged stems, flowers and buds dry up and fall off. Saprophytic fungi and bacteria fall into the damaged parts of the pods and rot them. Each worm can damage up to 15-20 bolls, flowers and nodes of cotton during the development period [20; p. 40-45].

A method of pre-determining (predicting) the development of cotton wool. In Uzbekistan, the development of the cotton plant is estimated based on the method developed at the Scientific Research Institute of Plant Protection. According to this method, butterflies of the wintering generation begin to fly when the ten-day average air temperature exceeds 110 C and the temperature of the soil at a depth of 10 cm exceeds 160 C. From this ten days of the month, the total effective temperature is calculated. When the effective temperature reaches 5500 C, jointing is completed, a new one begins, and so on. According to this method, when the average ten-day temperature drops below 250 C in August and the cotton begins to open, the pest's wintering population begins to form from the first age. How well the pest prepares for the winter and its ability to develop in the next ear will depend on the total effective temperature accumulated by this population. If this indicator is equal to at least 3500 C (the temperature necessary for the full development of the worm stage), the pest will easily overwinter. Thus, this method makes it possible to roughly determine the appearance of cotton bollworm (short-term and long-term) and successfully fight against the pest [50; pp. 57–58, 71; p. 132].

Carried out ecological monitoring and mapping with the help of ArcGIS. In this case, he studied more changes in the composition of the air in the environment [95; pp. 316–320]. The level of occurrence of parasitic entomophages of the cotton bollworm in the Agrobiocenosis was studied. When analyzing eggs collected from agrobiocenoses, it was found that 14% were infected with trichogram [33; pp. 23–27].

Ways to increase the effectiveness of biological protection of cotton are shown. in the experiments, in the organization of biological control, an additional harvest from 3.3 to 5.0 centners per hectare was obtained, and the profit from this harvest was from 283.8 thousand to 430 thousand soums per hectare. [10; p. 56, 19; p. 56, 67; pp. 97–100].

The technologies of using chemical methods against cotton pests and increasing the role of biological methods have been researched due to the analysis of environmental factors. [15; 540 - p., 55; p. 23].

The damage caused by cotton bollworm in Uzbekistan was analyzed. In addition to cotton, 30-40% of crops such as cotton, vegetables and other crops such as wild cotton, autumn cotton die. It is not accidental that the dynamic change in the number of insects depends on environmental factors [15; p. 540].

A. Anorboev, R. Jumaev studied species and dangerous criteria of representatives of the Noctuidae family in the cotton biocenosis, their parasite-host relationship [18; pp. 40–45]. Damage to cotton and other crops is increasing ear by ear. Red clover (Adelphocoris lineolatus Coeze). It is a pest that affects plants such as cotton, alfalfa, peas, and beets. The alfalfa weevil infects the bolls, flowers, and bolls of cotton. Severely damaged pods and flowers dry up, the fiber in the pod decreases, and its quality also decreases [148; p. 192].

The size of alfalfa is from 6.5 to 9.5 mm. Black or ellowish-green, males are darker than females. There are two black dots on the shoulder, which is the main distinguishing feature of the alfalfa kandala. Candala overwinters as eggs inside plant stems, especially alfalfa and other weeds. As soon as the spring starts to warm and the grass grows, the larvae begin to emerge from the eggs. In the conditions of Uzbekistan, alfalfa gives three to four generations throughout the summer. After the alfalfa is harvested, it flies to cotton and other crops under cover [15; p. 540].

Lygus pratensis L. It is similar in shape to an alfalfa kandala, but slightly smaller. It has a length of 3.5-4 mm, a green, black flower. The tip of the egg, which is 1 mm long, is slightly crushed. The larva differs from the mature kandal in that it is smaller and has no wings. In early spring, kandala feeds on various grasses and cultivated plants [156; p. 448].

Candala lays eggs on leaves and leaf bands. The incubation period lasts one and a half weeks. The development of the larva lasts 25-30 days. Beetroot, sorghum, hemp, hemp and cotton are among the most popular plants of Kandala. It infects all above-ground parts of cotton from early spring to late fall. It causes damage to the growth point and young leaves from grass emergence to tillering, sheds spikes and nodes during tillering and flowering - seed production. Dark sunken spots appear in the affected cysts, their development and maturation are delayed. Kandala gives birth 3-4 times a ear in the conditions of Uzbekistan [155; pp. 48–50, 170; p. 354].

Due to the fact that the apple borer causes the greatest damage in the conditions of Uzbekistan and only chemical preparations are used in the fight against it, it is under the constant supervision of experts [162; p. 352].

To fight against these pests, mostly toxic chemicals are used and great damage is done to the environment. There is a risk of the presence of chemical compounds harmful to human health in the cultivated products. Although biological methods have been widely used in the fight against cotton pests in recent ears, the problems of growing bioagents and obtaining high efficiency from them are waiting for their solution. Environmental monitoring systems based on new GIS technologies are being developed to protect agricultural crops from harmful organisms.

Cytosporosis disease. Cytosporosis disease of apple is one of the diseases caused by drying of plant branches. This disease occurs in most fruit and ornamental trees, except for apples. The first information about cytosporosis was recorded in scientific sources of the 19th century. Currently, this disease is recorded in a number of countries: Italy, France, Japan, Greece, USA, Hungary, Markash, Romania, Germany, Canada, Syria, Turkey, Holland, Denmark, Czech Republic, Slovakia, Tunisia, Kazakhstan, and Uzbekistan. [29; p. 340, 58; p. 20].

Cytosporosis is caused by fungi belonging to the genus Cytospora. There are two different opinions about the disease caused by representatives of this fungus. Proponents of the first opinion say that Cytospora fungi live saprophytically on dead branches and accelerate their growth [41; 52- p., 42; 15-19 p., 43; 11-31 p]. Others, on the contrary, say that they cause diseases in plants and cause the death of trees [61; p. 20].

In Japan, K. Togache (1924) reported that the disease caused by Cytospora fungi causes the death of trees [139; pp. 1–7], in the USA by A.W. Helton (1961) [99; pp. 152–157, 100; pp. 272–275], put forward in Germany by B. Kaltschmidt (1983). A number of researchers Florova I.P (1968), Kodyakova T.E. (1970), I.S.Popishoy (1971), A.Israilov (1974), V.I.Potlaychuk (1976) and M.Isin (2007) demonstrated its occurrence in fruit trees. [22; p. 340, 32; pp. 67–71, 42; pp. 15–19, 41; pp. 11–31].

A.S. Bondarsev (1931) and N.A. Naumovs (1952) stated that Cytospora fungi often cause the development of weakened trees [11; p. 459].

M.I. Cytospora capitata Sacc.et Schulz and C. Personata Fr. Fungal species are believed to be the cause [29; p. 340].

A number of works have been carried out on the study of the pathogenesis of diseases caused by fungi belonging to the genus

Cytospora and the biological characteristics of their causative agents. The role of representatives of this group in the drying of fruit trees in the conditions of Georgia by T.A. Sakadze (1972) T.A. Sakadze, T.G. It was studied by Shelia (1954). Using the method of artificial infection of plants with these types of fungi, their pathogenicity was studied. Cytospora capitata fungus from dead apple branches. Sacc. et Schulz. Type extracted. According to the author, due to the toxins released by the fungi, plant branches dry up and necrosis occurs in them. In addition, they also studied the morphological and biological characteristics of pure cultures of Cytospora fungi [63; pp. 114–127, 64; pp. 34–35].

E.P. Kropie (1957) studied the premature withering of pome fruit trees in Moldavia. In order to study the pathogenicity of the Cytospora fungi isolated from the diseased trees, the researcher observed that most of them were infected with the disease when he artificially infested the fruit trees [8; pp. 87–91].

M.M. Kurbanov (1977) believes that representatives of this group are the cause of the establishment of seed and grain fruit trees in Azerbaijan [35; p. 18]. E.A. Dvoychenkova (1962) found out that representatives of Cytospora genus are responsible for the drying of apple trees in the Moscow region. In the central black soil zone of Russia, Cytospora schulzeri Sacc. Eat Syd. distribution of the species was studied by M. T. Khomyakov (1971), who concluded that this fungus is a facultative parasite [56; p. 21].

A.A. Ablakatova (1965) Sytospora saritata Sacc et Sehul: fungus. He found out that in the Far East of Russia, it was the reason for the establishment of not only grain fruit trees, but also apple and pear trees. When the healthy branches taken from healthy and diseased apple trees were artificially infected with this fungus by the author, the branches taken from the healthy tree were not infected, but the branches of the diseased tree were observed to be infected, so the fungus that causes this disease is facultative. concluded that the parasite [31; p. 346].

T. E. Kodyakova studied apple cytosporosis in the Chuy Valley of Kyrgyzstan. It is Cytospora schulzeri Sacc. Eat. Schulz found that the fungus is a weak pathogen. The author of Shy Cabal came to the conclusion that the disease of apples in the Chuy Valley is caused by complex factors, that is, the noculia became weak due to weather conditions, and the fungi of Sutosrora on the trees cause the disease [32; pp. 67–71].

In the Republic of Uzbekistan, information on the occurrence of cytosporosis of fruit trees by fungi of the genus Sutosrora can be found in the scientific works of M.S. Panfilovani (1950-1956). The pathogenic properties of these fungi have been proven by artificial infection of fruit trees. The author notes that more fruit trees are affected by cytosporosis, and apples are less affected by this disease, and puts forward the opinion that it is caused by weakening [41; pp. 52, 43; pp. 11–31].

In the monograph of Magjan Isinni (2007) dedicated to the genus Sutospora, which causes cytosporosis, the representatives of this genus were comprehensively evaluated, and their taxonomy, biology, and parasitism characteristics were widely discussed [29; p. 340].

O.T. Khojaev (2010) also studied cytosporosis. The researcher showed that cytosporosis disease is more common in the mountainous region than in the plains and sub-mountainous regions. Due to cytosporosis disease, it was found that the number of fruits on tree branches decreased and the weight of ripe fruits was lost by 5.8-26.8% in apples and 3.8-20.2% in pears. It was observed that the Golden, Delishes, Borovinka Tashkentskaya, Jonaton, pear Royal zimnaya and Lyubimitsa, Klana varieties are resistant to cytosporosis. When combined with 0.044% Bayleton, 11.9% apple, 14.2% pear, 0.2 Soprel, 11.5% and 11.5% yield were saved in the corresponding field [58 ; p. 20].

Ecological monitoring is a complex system of observing, evaluating and predicting changes in the state of crops and trees under the influence of natural and anthropogenic factors. The entire system of monitoring is divided into levels and departments. The levels of environmental monitoring are divided into global, regional and local groups according to the scale of data summarization. Departments of ecological monitoring are determined by the specific characteristics of dimensions and methods of monitoring and evaluation and are divided into biological, ecological and economic departments. In our opinion, such horizontal and vertical division fully covers the entire system of environmental monitoring. The main task of monitoring is to obtain objective information about changes in the biological, ecological and economic dimensions of the environment at the global, regional and local scales as a single basis for making decisions on plant protection. consists of [73; pp. 2467–2485]. In recent ears, despite the availability of recommendations developed by experts and accepted for use in agriculture, the damage caused by pests and diseases to agricultural crops due to non-compliance with them is still not decreasing. Scientifically based integrated control system for protection of plants from harmful organisms is a set of agrotechnical, biological, chemical and other methods of control that can meet the requirements of the era. it includes measures and activities that can preserve the purity of nature and allow to grow quality crops. All this should be based on forecasts of pest, disease and weed development. This, in turn, requires the development of long-term and short-term forecasts of the development and spread of harmful organisms of the main agricultural crops and the planning of protection works based on them in advance [16; p. 168].

Planning of plant protection measures is based on taking into account the phytosanitary status of crops, information on the development, spread and damage of existing harmful and beneficial insects in nature. Current and long-term plans are drawn up for the purpose of timely and effective use of plant protection measures. These plans include agrotechnical, chemical, biological control methods and organizational measures. Current and long-term plans are made based on predictions of changes in the phytosanitary situation in each region. In the plan of organizational activities, indicators such as protective works to be performed, sequence of execution, time, type of work, forms of organization of work and technology of execution, payment for labor should be reflected. necessary [17; pp. 18–19]. The plan of agrotechnical measures should consist of soil cultivation, organization of crop rotation, use of mineral and local fertilizers, chemical and biological control measures [164; p. 56, 70; pp. 408–410].

Plans for the use of biological control methods should be drawn up taking into account the duration of cultivation of beneficial insects (trichogramma, bracon, golden eye, etc.) in existing biolaboratories and biofactories, and the size of the areas to be processed [69 p. 280, 71; p. 132]. These indicators, in turn, are based on short-term and long-term forecasts of the development and spread of pests and diseases, as well as the duration of their appearance. The creation of a plan of chemical control methods allows determining the quantities of chemical drugs (required for each ear) that are required for all regions, are allowed to be used on the territory of the republic, and are harmless to the environment. Protecting agricultural crops from pests (cotton moth, autumn moth, spider mite, harmful insects, aphids, etc.) and diseases (wilt, root rot, gommosis, rust diseases, etc.) the planning of the events directly depends on the forecasts of the duration of their occurrence, density (number) and the size of the areas that can be spread. Forecasting and using these indicators, studying the relationship of harmful organisms with the external environment allows to develop long-term and short-term forecasts of the development of pests of cotton and other agricultural crops. Timely implementation of these forecasts will increase the efficiency of protection works organized and carried out on the basis of a plan in all cultivated areas of our republic several times. Science-based forecasting is the basis for early determination of the scope of works to protect plants from pests and diseases, necessary equipment, methods and tools, materials and labor and their proper planning. In order to achieve positive results in the fight against harmful organisms, it is important to collect relevant information about their natural state, factors influencing their development, and ecological environment quickly and to the required extent. For this, it is necessary to automate the processes of collecting this data, processing it, making optimal decisions based on this data and delivering it to users. The development of an automated system of collecting, storing and processing information, as a result, an information system provides an opportunity to identify information that affects the development and spread of harmful organisms. It should be noted that in the conditions of our republic, most of the tasks of protecting plants from harmful organisms are territorial in nature. This is explained by the fact that changes in the composition of cultivated areas, types of harmful organisms and their spread processes also lead to changes in protective measures. For this reason, the recommendations developed for one region cannot be directly applied in other regions. This, in turn, requires the creation of a regional database, the unification of information systems [66; p. 47]. Long-term planning of means of protection of agricultural crops from harmful organisms should be based on long-term forecasts of their development and new technologies of crop cultivation. This, in turn, requires the development of automated methods of planning. Such methods have not been sufficiently developed to date. The reason is that it is difficult to collect the necessary information for the implementation of these works, and in some cases this information is not taken into account at all. Nevertheless, researchers are looking for automated ways and methods of mathematical modeling, forecasting and planning in the field of agriculture (including plant protection). It is necessary to develop such mathematical models, algorithms, computer programs, and create a database for planning and organizing plant protection work based on them. The accuracy and sufficiency of this information ensures alternative decisions [9; pp. 3–40].

It is known that it is important to increase the level of automation in all areas of production, including agriculture, and to use information and communication technologies in the agricultural sector. Therefore, in the process of growing plants and protecting them from diseases, the issue of introducing the basics of "phytomonitoring" is one of the urgent tasks of today. Here, one of the main tasks of phytomonitoring is to analyze the condition of plants, to determine the reasons for their development lag or damage caused by harmful organisms. Having such quick information about the state of plants allows to make changes in the technology of their cultivation and create optimal conditions for them. [80; pp. 998–1006, 88; p. 158].

It is necessary to improve these technologies using the achievements of modern science, and on this basis, develop technologies for early prediction of crop pests. A thorough study of the bioecological features of pests is a scientific basis for the development of low-cost forecasting methods. Forming a GIS database based on this information is important in solving the following problems.

In addition to the above, based on the situations that have arisen in recent ears in our Republic, labor-intensive technologies are used to determine the damage caused by harmful organisms of agricultural crops. It is necessary to improve these technologies using the achievements of modern science, and on this basis, to develop technologies for early prediction of crop pests. A thorough study of the bioecological characteristics of pests is a scientific basis for the development of low-cost prediction methods. The following conclusions were made based on the information presented in the literature.

Conclusions on Chapter I

1. Creation and implementation of development monitoring systems of harmful objects of agricultural crops based on GIS technologies.
2. Solving the problems of pre-planning of protection against harmful organisms of cotton, orchards and other crops
3. Based on GIS technologies, to identify the areas prone to the spread of agricultural crop pests and develop preventive measures for them.
4. Creation of a database for the development of methods for remote detection of the development of pests and diseases, the biological characteristics of which have been studied in depth.
5. Compilation of phenological calendars of their development and determination of their development, distribution and damage levels based on weather conditions.
6. Improvement of control measures, taking into account the economic damage limits of harmful organisms of cotton.

7. Development and implementation of a monitoring system for the development of the main pests of cotton and planning of protection against them.

II-chap. RESEARCH LOCATION, CLIMATE CONDITIONS AND WORKING METHODS.

2.1-§. Soil-climate conditions and working methods

Khorezm region is located in the north-western part of the Republic of Uzbekistan, in the lower reaches of the Amudarya, more than 80% of its territory is on the left bank, and the rest is on the right bank. It is located between the Kara and Kyzylkum deserts, the total land area is 6.3 thousand square kilometers, and the rest is the land on the right bank. To the west, south-west and south, the region is mostly bordered by the Karakum dunes behind Unguz of Turkmenistan, and by the oases of Karakalpakstan and the sands of Bukhara region to the north-west and north-east. A large part of the border passes with Karakalpakstan from the north-east, and partly over the Republic of Turkmenistan and Amudarya from the south-west. Khorezm region is located between 410-420 north latitude and 600-610 east longitude, 200 km southeast of the Aral Sea, which is in an ecological crisis, on the ancient delta of the Amudarya River, and it forms oasis meadow alluvial soils [150; pp. 45–48].

The climate of the Khorezm oasis is sharply continental, the long-term average evaporation is very high - 1400 mm [161; pp. 133–219, 68; p. 88–89] and is characterized by the fact that the amount of precipitation is very low - 92 mm. Therefore, the production of agricultural products directly depends on the only source - the water brought by the Amudarya River. According to the Scientific Research Institute of Irrigation and Water Problems [181], the amount of water consumed in Khorezm region is 4.5 km3, 90% of which is used in agriculture [27; p. 272]. The soils distributed in the Khorezm region are 100% saline, and depending on the level, salt washing measures are carried out 1-3 times. Taking into account the water demand of crops and the salts in the soil layer during the growing season, it is necessary to put a large amount of water in the fields [146; p. 270].

The land area of the region consists mainly of a plain, sloping from the south-east to the north, and is located at an altitude of 95-105 m above sea level. Man's work for many ears has changed the natural surface of the earth. [150; pp. 45–48].

Climate: The climate and nature of the Khorezm region has its own characteristics. Factors such as Kyzylkum and Karakum deserts, the Aral Sea, solar radiation, topography of the area, atmospheric circulation and the ecological condition of the area play a major role in the formation of the climate of the oasis. During hot periods, the Turanian lowland is affected by extremely low air pressure caused by the scorching hot temperature over the desert regions. In the regions of the central desert, when the thermal depression is in full swing, the extreme air temperature reaches 45-490C, and there are cases of warming of the earth's surface to +700C or even higher. Under the influence of winds blowing in the north and west direction, this thermal energy makes it possible to raise the air temperature in the region to +43- +450C.

The average annual climate indicators are given according to the data of Khiva and Urganch weather stations (see Table 2.1). The climate of the region is characterized by extreme dryness and aridity, dry summer heat, cold winter, as well as large daily and annual temperature fluctuations. Due to the absence of natural barriers in the northern and eastern parts of the region, the cold air masses blowing from the Arctic and Siberia created favorable opportunities for entry. This causes the air temperature to drop to -30 - -350C in winter. Therefore, the climate of the region is sharply continental, and its annual amplitude is very high. The difference between the maximum and minimum temperatures reaches 780C.

The spring season in the region is characterized by a sharp rise in air temperature and intensity of precipitation.

2.1-table

Long-term average data of climate indicators in Khorezm region

Indicators	Average monthly												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
According to the information of the Urganch weather station													
The air temperature ^{0}C	-3,9	-2,5	4,8	14,3	21,6	26,3	28,1	25,7	19,4	11,4	3,8	-1,8	12,3
Rain, mm	7	10	18	16	9	4	2	1	2	4	10	11	94
Relative air humidity %	77	73	67	54	41	37	41	45	49	56	66	78	57
Days with dust storms	0,2	0,6	0,6	1	0,8	1	0,6	0,4	0,2	0,2	0,1	0,04	6
According to Khiva weather station													
Air temperature ^{0}C	-3,7	-1	5,6	14,7	21,7	26,0	27,6	25,0	19,1	11,8	4,1	-1,6	12,4
Rain, mm	9	12	22	15	9	3	3	1	2	5	8	11	100
Relative air humidity %	77	73	66	55	43	42	48	53	55	60	68	78	60
Dusty days	0,1	0,3	0,5	1	0,8	0,7	0,4	0,3	0,2	0,2	0,1	0,03	5

Due to the increase of rainy days, the strengthening of winds blowing in the north and west direction, the maximum level of air humidity (80-90%), and the repetition of the exchange of one air mass with another air mass, the air temperature changes dramatically. It is distinguished by a number of features such as standing. Although the weather in the first half of spring is quite humid, it does not differ much from the weather in winter. At this time, the minimum air temperature can reach -150C, -170C. Only from the second half, the days start getting warmer. In spring, the average temperature is around +110 +160C. The summer season lasts from the first decade of May until the middle of September and is 125-135 days. Summer is very hot and dry season. The average absolute maximum reaches 40-410S. Summer is the least rainy season, with only 10% of annual precipitation falling in summer, with a total monthly precipitation of 2 mm. In autumn, north and west winds prevail. During this period, the speed of the wind increases to 15-20 m/s, at such times plants suffer great damage, their fruits fall, trees fall and break. The clouds are increasing and the days are getting colder. The air temperature ranges from +50 to +200C. 20-25% of the average annual precipitation falls on the autumn season.

30-35% of the annual precipitation falls in the winter season. Such a sharp drop in temperature is due to the influx of cold Arctic air from the north. In winter, the cooling of the air temperature causes the soil to freeze to a depth of 28-70 cm, which causes some difficulties in plowing and washing the land. In the territory of the region, the annual cold days average 164-165 days, while the winter season lasts 120-140 days.

Due to the small amount of rain that falls in the oasis (80-90 mm) and it also rains repeatedly, it does not reach the deep layers of the soil, it is absorbed only in the agro-irrigation plowed layer of the soil. does not fill water reserves. Due to the abundance of sun in the summer, the area is rich in solar radiation, and each m2 receives 140 kcal of heat. As a result of dry air and intense solar radiation, water evaporation is 18-20 times higher than the average amount of precipitation [165; p. 340].

Syzot waters rise up through the capillary pores of the soil section and in the surface part of the soil, i.e. in the tillage and sub-tillage layers, there is a mass of salts that have a negative effect on the germination, growth and development of plant seeds. leads to planing [146; p. 270].

As of 2000, there were 1,987 monitoring wells in the area, which were investigated based on the 1990-2000 GIS database development [181]. In this study, 27 ears of data from 1990-2016 were analyzed with data from 2001-2016. Monitoring wells are installed evenly along the irrigated land areas of the region.

The groundwater level was measured every 5 days during the growing season (March-August), and every 10 days during the off-season. In the following ears, as a result of increased attention to improving land reclamation, data was collected on the basis of 2150 monitoring wells. Measuring the level of underground seepage water was measured using special sounding equipment placed inside the well, and the water level data was determined. Data are collected three times a ear to determine the mineralization of groundwater. Measurements are taken in April in order to provide moisture to the soil before preparing the crops for planting and to wash the salts accumulated in the soil layers [159; 340-b].

For this reason, it is important to monitor the dynamic changes of groundwater mineralization over time, to determine its periodic and regional characteristics. July of the summer season is the peak of irrigation of agricultural crops, and intensive irrigation is carried out. October is the month of the end of the vegetative period of the main agricultural crops, and it is possible to estimate the rate of decrease of the groundwater level when the surface water does not affect the underground. It is very important to study the dynamics of the groundwater level at the beginning of the non-vegetative stage, because in this period (October) the process of soil salinization accelerates as a result of the upward movement of groundwater with the end of seasonal irrigation.

The mineralization of groundwater can be different: dry residue in non-saline groundwater is 0-1 g/l, in areas with low salinity it is 1-3 g/l, in areas with medium salinity it is 3-10 g/l, 10-15 g/l in highly saline areas, and if it has a higher level of mineralization, it is considered uncultivated. The level of soil salinity is in the same order: soils with a total salt content of less than 0.3% are not saline, 0.3-0.7% are moderately saline, 0.7-1% are strongly saline, and 2% are saline soils. is called [150; pp. 45–48].

That is why agricultural crops are cultivated only by artificial irrigation. Also, in regions with saline soil, including all cultivated areas in the Khorezm region, it is required to wash the soil every ear depending on its salinity level.

Soils. The evolutionary development of the soils of the Khorezm region and the change of the soil layer towards the pactga, the formation of the soils of the region took place mainly in the conditions of a constant hydromorphic environment for many centuries. He described the variety of soil cover of Khorezm region. Further studies have shown that the ancient alluvial plain currently contains previously defined soils. Only now their quality ratios have changed. Meadow alluvial soils, including irrigated soils, are distributed over the most areas. In recent ears, the expansion of irrigated areas due to the development of soils that are difficult to meliorate, the area of meadow alluvial soils where agricultural crops are planted is expanding even more [59; p. 133-210].

Land reclamation. The territory of the Khorezm region is characterized by a very weak natural underground flow and a lack of artificial water-carrying facilities. Similarly, irrigated and non-irrigated soils were subjected to salinization [151; p. 320]. Currently, in the populated part of the region, there are more weakly saline and washed soils (37.2% of the total land fund) [73; pp. 2467–2485]. In Gurlan, Shavot, Koshkopir and Urganch districts, non-saline soils are not separated. They are included in weakly saline soils. Because together they make up 15-20% of the total area of the district. It should be noted that the weight of weakly saline and leached soils changed little over the next ten ears. The area of shorkhoks has been greatly reduced, their weight in the land fund is 1.6%. The reduction of the area of shorkhoks, the introduction of land into agriculture is the acceleration of reclamation works. Due to the development of hard-to-develop lands, the average salinity area increased by 15% to 26%, and the highly saline area increased by 8% to 18%. This worsens the reclamation condition of the general lands of the region [59; pp. 133–210]. Land reclamation condition is determined by its mechanical composition. Medium sandy (30% of the land fund) and light sandy (21.6%) soils make up more area in the region. The rest consists of sand and sandy soils. Soils with such a mechanical composition occupy a large area in Koshkopir, Urganch, Bogot districts (50-69%). Sand and sandy soils (27-41%) occupy the area in Khiva, Khazorasp, Pitnak districts. Soils with different mechanical composition are widespread in the region. They lead to the emergence of a unique environment that differs from each other in the scattered fields. For example, the rise of underground water to the surface and its evaporation from the surface of the earth causes specific physiological changes in crops. As a result, there are favorable conditions for the development of pests in certain places [59; pp. 133–210].

2.2-§. Research methods

In the conditions of the Khorezm oasis, insects that cause great damage to agricultural crops - tree and cotton pests (cotton borer), as well as cytosporosis, a dangerous disease of apple trees, were studied.

Landsat 5 TM and Landsat 8 OLI images were used during the research ears (2012-2017). Aerospace methods and GIS technologies have great potential for assessing and mapping the possibilities of production of products on agricultural land [12; p. 120]. The research ear was 2013-2017, multi-zone Landsat images, the arithmetic average value of the maximum biomass accumulation index (NDVI) of crops during the growing season was calculated, the cultivated areas of Khorezm region and districts were mapped.

Since the use of GIS technology elements in ecological monitoring of the development of these insects and their damage and their control is being researched for the first time in our republic, some research methods have been adopted or mastered in the work process.

RapidEye consists of a system of 5 satellites in Earth orbit, 5 spectral zones with a geometric resolution of 6.5 meters (blue zone 440-550, green 520-590, red 630-685, red and near infrared bandgap 690-730 and near-infrared 760-50 nm) are provided with optical data. The data from the

Landsat satellite was analyzed based on the RapidEye data, which has a very high level of accuracy [6; p. 20].

In classification based on pixel and object, Landsat image 6 spectral channels (1-6) and Landsat 8 image 7 spectral channels (1-7) and vegetation indices and multi-zone data were analyzed using mathematical methods. The analysis was performed using R-Studio, ENVI 4.5 and ArcGIS 10.0 software. A total of 3 algorithms for classification of space images based on the minimum size (pixels) on the ground, non-linear differential algorithms, namely RF (random forest) and SVM, using R-Studio and MLC (maximum similarity classifier) methods AcrGIS software was carried out using The classification of agricultural crops was carried out in the R-Studio environment and with the help of AcrGIS software on the basis of space images. These classification algorithms were used to extract cotton cultivation areas (Appendix 1). NDVI indices were determined by the following formula based on the data obtained by the Landsat 8 OLI satellite of the cotton field areas [12; p. 120].

$$NDVI = \frac{\mathrm{nir-red}}{nir+red} \qquad [1]$$

The pests that spread in Khorezm region and cause great damage to other regions of our republic were studied mainly in the conditions of this region. Monitoring works of the Goza tunnel are carried out in Urganch, Yangibozor, Koshkopir, Khanka of the region. It was conducted in Khiva, Gurlan, Shavat districts. For example, the research of the Asian locust based on GIS technologies was conducted in the Moynaq district of the Republic of Karakalpakstan. This research was carried out with the help of the staff of the "Locust Control Service" of the Republic of Karakalpakstan. Also, the fight against the Moroccan locust was carried out on the basis of GIS technologies. Development of GIS system against locusts was also carried out together with FAO staff. Data collected from the GPS-navigator and other sources were represented by maps using samples of the digital map of the Khorezm region developed in the GIS laboratory of UrDU, organized within the framework of the project carried out on the basis of the cooperation of the German University of

Bonn (TsEF UNESCO) and Urganch State University. In order to compare the collected data with soil, water and other ecological conditions, based on the data developed by the project (TsEF UNESCO), using the information available in the UrDU database, the arrangement of crops in Khorezm region conditions, soil salinity level, land maps were developed on the level of salinity of groundwater, the amount of soil humus, and the mechanical composition of the soil. Data from MODIC and LANDSAT satellite archives were used for remote sensing research (see Figure 2.1).

Mini-meteorological stations were installed in 9 fields at a height of one meter (Appendix 2) and air temperature and humidity were automatically measured every two hours. The average values of the collected data were obtained.

Figure 2.1. NDVI level of plants is the average indicator of 2013-2017 (M. Sultonov reports)

Determining the amount of pests in the field was determined according to the methods developed by ITI (Scientific Research Institute) of Plant Protection of Uzbekistan. (Methodological guidelines for testing insecticide, acaricidal biologically active substances and fungicides, 2007).

Experimentation and statistical analysis of data B.A. It was conducted according to Dospekhov (1985). Testing pesticides A.G. Makhotkin, V.A. Pavlyushin. The methodical instructions of Sh.T.

Khojaev for the biological economic efficiency of pesticides were used [15; p. 540].

According to M.K. Khoryakov, isolation of fungi from plants by Avramova's method, use of preparations in acceptable standards. In fields infested with a pest, field damage was studied through 100 plants, and the number of damaged plants was determined by dividing it by its total number..

$$U=(a/b)*100 \qquad [2]$$

In this:

U - the total damage level of the field.

a- the number of infected plants.

b- the number of studied plants.

The biological efficiency of the insecticide was calculated based on the following formula according to Abbott:

$$C = \frac{(Aв - Вa)}{Aв} x100 \qquad [3]$$

Here S is biological efficiency.

A – number of pests before spraying.

a – number of pests after spraying.

V – the initial number of pests in the control field.

v– the number of pests after treatment in the control field.

In 2013-2017, field observation studies were conducted in Khorezm region in Khanka, Urganch, Yangibozor, Khiva districts to study irrigation water and the development of cotton cultivation in the region. Four fields with an average area of 5 hectares were selected from each district, and the number of cotton bollworm larvae was determined every ten days. In order to study the relationship between the NDVI index and the prevalence of bollworm, in 2017, 84 cotton fields were randomly selected in Pitnak, Koshkupir, Yangibozor, and Khanka districts (see Figure 2.2). According to the research method, a total of 100 cotton plants were examined from 20 places along the diagonal of each field. During the observations, the number of larvae found in each plant was recorded.

The damage level of cotton fields was expressed by the average number of cotton bollworm larvae per one plant.

Sh.T. Khodjaev, Z.K. Adylov, A.A. Abduvahabov and dr. s.x. culture" (1985). N.V. Bondarenko, A.F. Glushchenko "Praktikum po obshchey entomologii".- (1985). Kh.K. Yakhaev., Kh.Z. Abdullaeva "Information technologies in the development of the agricultural sector: monitoring; forecasting; planning; management". (2016) S.Avezbayev, O.Avezbayev "Geodatabase and architecture" (2015) Statistical analysis of experimental results using Microsoft Excel computer B.A. In the methods of Dospekhov (1985) [5; p. 351] and mathematical-statistical analysis was performed according to the R-studio algorithm.

Research was conducted in the parks between Khanka, Urganch, Khiva districts. The Renet Simirenko apple variety was checked, the Orchards were established in 2005, and diseases have been monitored since 2013. The coordinates of the inspected areas were determined using GPS (Appendix 3). Cytosporosis disease was checked in 50 fields from these fields. 20 trees were studied diagonally from each field. A total of 1,000 trees were examined from 50 areas. GPS research was carried out in orchards and cotton fields in cooperation with the employees of Khorezm Regional Agrochemical Protection LLC and biolaboratory managers. Samples were taken from damaged trees and analyzed in the laboratory. (Appendix 5).

Samples were sterilized with 75% alcohol and cultured on wort and water agar. It was taken from the fungi that came out of individual cells and planted in fresh agar water. It was viewed under an optical microscope at a magnification of 1000 times. The information on the morphological features of the fungus was compared with Mehrabi M, Mohammadi Goltapeh, Fotohifear K.B (2011), pictures and other information from experiments. Information on the level and salinity of groundwater was obtained from the reclamation expedition facility [11; p. 42].

For GIS analysis of cytosporosis disease, a database on the level of groundwater in the surveyed fields is necessary.

Figure 2.2. Areas where research was conducted on the spread of cytosporosis disease and the study of groundwater levels in apple orchards.

In the Khorezm region, more than 2,100 wells designed for continuous measurement of the level of underground water are checked every 15 days by the employees of the Khorezm reclamation expedition (Appendix 5). Data from the Khorezm land reclamation expedition were used as a database for the analysis.

Location of wells for measuring groundwater in gardens where cytosporosis was studied (see Figure 2.3). In addition, research was conducted in apple orchards of Khanka, Urganch, Khiva districts. The map shows the density of irrigation and reclamation systems.

Apple orchards are planted in a 6x4 scheme. Spraying was carried out using an OPV-1200 sprayer.

Disease prevalence was determined based on the following formula:

$$P = (n/N) * 100 \qquad [4]$$

P- spread of disease

n- total number of studied trees

N- total number of infected trees

The effectiveness of fungicides was determined based on the following formula:

$$Э = \frac{Пк - По}{Пк} \qquad [5]$$

E- efficiency

$П_k$ – damage to the plant under control

$П_o$- damage to the experimental plant

The prevalence of the disease was determined based on the following formula:

$$P = \frac{\text{E (a} * \text{в)} * 100}{N * K} \qquad [6]$$

R- disease prevalence

E (a*v) - the sum of the number of members affected by the disease multiplied by the number of points

N – the total number of observed plant members

K- the highest score on the scale

$$C_{ф} = X_{H} - X_{ap} \qquad [7]$$

$C_{ф}$ – net profit, coum;

X_{H} - the price of the harvected crop, coum;

X_{ap} – all expencec, coum.

Profitability ic calculated ac followc:

$$P = C_{ф} / X_{ap} \text{ x } 100 \qquad [8]$$

Chapter III. USE OF GIS TECHNOLOGIES IN ECOLOGICAL MONITORING OF PESTS OF AGRICULTURAL CROPS.

3.1-§. GIS technology in the study of bioecological characteristics, distribution and development of harmful locusts

Moroccan (Dociostaurus maroccanus Thunb.), oasis (Calliptamus calliptamus L. S. turanicus Tarb) and Asian (Locusta migrotoria L.) species are widespread among the locusts that cause major damage to agricultural crops in Uzbekistan [23; pp. 22–23].

The Asian locust is one of the most dangerous insect pests with mass reproduction, which in some years creates swarms in very large areas and poses a constant threat to agriculture. In particular, its population along the Southern Island or in the lower Amudarya basin increased dramatically in 2000-2001, causing a number of problems in this basin, and a lot of money was spent to fight against it. Although a number of research studies have been conducted to study the bioecological features of the population of the Asian locust in this area, a number of practical changes are being observed in the course of the development of this pest in connection with the drying up of the Aral Sea. In 2010, the wettest period of the Amudarya in the next 15 years was recorded, and most of the river delta and its lakes were filled with water. In the fall season of 2012, in the regions of Moynaq, Kungirot, Kegeili districts of Qorkalpakstan, the large increase of Asian grasshopper around the lakes and reservoirs caused by the drying up of the Aral Sea and its wide spread in 2013-2014 due to the fact that there is a risk of spreading in the area, a number of tasks have been set by our government to prevent an emergency situation. (Record No. 217 of the meeting of the emergency commission for the fight against the epidemic, approved by the Prime Minister of the Republic of Uzbekistan on 15.10.2012). Based on this report, research work was carried out on mapping the Asian locust's spread and egg-laying areas in the island regions of the Republic of Karakalpakstan. In the experiments carried out in the Moynaq district of the Republic of Karakalpakstan, it was found that during 2012-2013, the Asian locust had the opportunity to multiply in this area. One of the main reasons for this is the constant change in the water level of the lakes in the delta basin. During the observations, it was found that the locust laid a large number of seeds (30-40 sq.m.) on the soil in a large area. In connection with this situation, a special commission of the Government was formed and worked to study it and prevent the danger.

Materials on GIS technology in Asian locust development and locust control work are provided. The GIS laboratory operating under the Urganch State University carried out research on identifying the area of Asian locust spread by remote sensing method. On the basis of the conducted work, the areas of Asian locust development centers located in the Amudarya delta were determined. The maps were developed (see Figure 3.4).

By determining the area of reeds, the areas where the Asian locust is spread in this area were determined. It was also possible to identify a water-covered surface basin in this area through remote sensing, and collect information about reed beds creating favorable conditions for the development of Asian locust in the future (see Figure 3.5). (UrDU GIS Center, MODIS status October, 2012). The Asian locust mainly lays more eggs in reed beds and has been found to make holes in the soil there and lay eggs inside. Where there is a lot of reeds, there are potential opportunities for the Asian locust to breed. Determining these areas in latitudes and longitudes requires a lot of work.

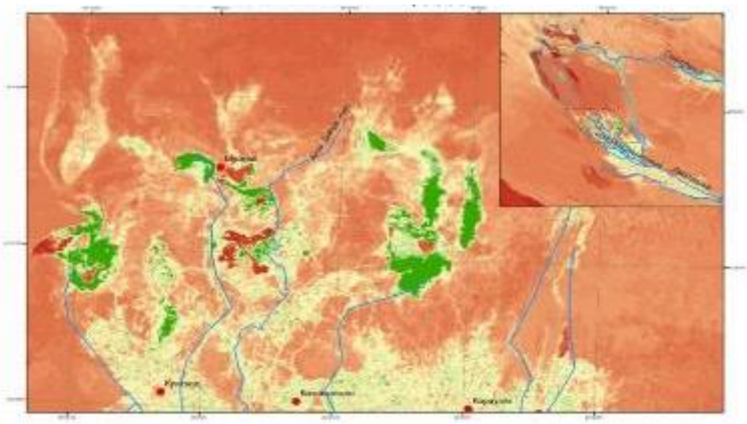


Figure 3.4. Area of reeds where the Asian locust can spread in the Lower Amudarya region. (UrDU GIS Center, MODIS. Status of October, 2012).

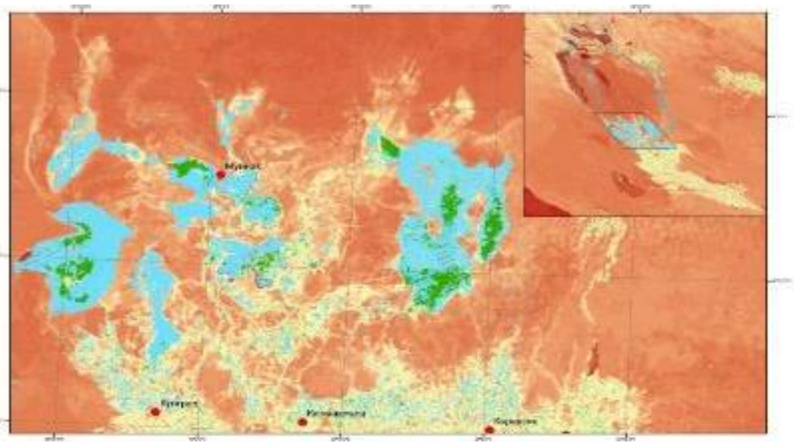


Figure 3.5. The area of reed beds and water bodies where the Asian locust can spread in the lower Amudarya region.

On the basis of the obtained results, practical support was provided for the planning and implementation of works against the Asian locust in the South Island region. The fact that there are 70,000 hectares of Asian locust spread, based on the data obtained from the International Satellite Database, revealed the possibilities of using GIS technology in the fight against harmful locusts for the first time in our republic.

In short, within the framework of this study, full information was collected on the spread of harmful locusts in our Republic or monitoring of their biology, fighting against them on the basis of GIS technology. In practice, work was carried out on the use of remote sensing methods to predict the development of Asian locust, and the results of these experiments were studied and developed to the level of practical use by the Ministry of Agriculture and Water Resources, Plant Protection and Agrochemical Center, Locust Control Service Organization. released (Appendix 6).

3.2-§. Importance of GIS technology in ecological monitoring of fruit tree pests.

3.2.1 Environmental monitoring of the distribution of the urban mustache beetle (Aeolosthes sarta) in apple trees.

One of the most dangerous pests for apple trees is the urban mustache beetle. This pest lives a secret life. After eight o'clock at night, the tree begins to emerge from its trunk. During this period, they will have few enemies. During this period, they mate and again enter the trunk of the tree. Female beetles lay eggs on bark. Males have dark brown head and chest, and brown legs. The whiskers are also brown, about twice as long as the body, and the belly is dark brown. The front wings are covered with small feathers. The base, middle, and tip of the wings are usually inconspicuous, forming only wing spots. The body is also covered with feathers. The feathers on the base, middle and tip of the wings are usually inconspicuous, forming only wing spots. The body is also covered with feathers. Brown color is also the main body color in female forms. The size of males is 38-40 mm, and that of females is 30-35 mm. Trees affected by this type of mustached beetles die in 4-5 years. Female beetles usually lay up to 50 eggs under bark, in tree cracks. The total development cycle lasts two years.

Damage to trees by the urban mustached beetle has attracted the attention of many researchers. This insect is considered one of the most dangerous pests for trees. The urban mustached beetle is polyphagous and infests several species of trees. We have conducted research on the degree of infestation of elm, poplar, apple, and willow trees by the urban mustache beetle. Searches were conducted in Khanka, Urganch, Kushkopir, Shavot, Yangibazar districts..

3.2 -table

In the conditions of the Khorezm region, the degree of infestation of apple trees by the urban mustache beetle, (%) (2012-2013)

№	Fog	In 5-year-old (young) trees	6-15-year-old (middle-aged) trees	On trees older than 16 years (adult).
1	Xonqa	-	7,4	15,2
2	Urganch	-	6,2	12,6
3	Qo‘shko‘pir	-	3,6	16,2
4	Shovot	-	5,4	10,2
5	Yangibozor	-	6,6	14,6

The coordinates of the heavily damaged areas of the studied trees were taken and put on the map. It was found that apple trees are more affected during the productive period (see Table 3.2). It can be seen that trees up to five years old are not damaged. After sixteen years, the trees began to suffer. Damage to trees during this period will shorten their life and reduce productivity. Because during this period, apple trees begin to bear fruit. Damage to apple orchards begins to increase in older apples, because in this period apple trees enter the aging period. In the conditions of Khorezm region, apple trees begin to dry after 15 years. This may be caused by the complex ecological situation in the region. By entering the samples into the GIS software base, we can analyze them by age and determine the distribution centers. Favorable conditions for the development of the pest appear in the foci of spread. For this reason, they multiply here and then begin to spread to other trees. In the areas included in the GIS database, there are opportunities for timely treatment of the foci of their spread.

3.3-§. Study on the basis of GIS technologies in ecological monitoring of fruit and ornamental tree pests.

3.3.1 Environmental monitoring of the urban mustached beetle (Aeolecthec carta Colck).

The urban mustached beetle is polyphagous and infests several species of trees. We conducted research on the degree of infestation of larch, poplar, and willow trees by the urban mustache beetle. Searches were conducted on the edges of motor transport roads and irrigation networks in Khanka, Urganch, Kushkopir, Yangibazar, Shavot districts. The coordinates were determined using a GPS navigator (Appendix 8). In each district, the degree of damage to larch is 2-90%, depending on its age.

M.A. According to Khudaiberganov, the urban whiskered beetle attacks physiologically weakened trees and healthy trees at the same level [25; pp. 44–45, 60; 18 p.,61; p. 39].

As a result of our research, it was learned that the weaker the plants, the more susceptible they are to damage by mustache beetles. We divided the trees into young, middle and old species and conducted research on them. Pine trees were classified by age as follows: young trees or trees up to 5 years old, middle-aged trees - from 6 to 15 years old, and mature trees - over 16 years old (see Figures 3.5 and 3.6).

The trees are shown as a 25-year-old infested pine tree located 50 meters from the irrigation source (see Figure 3.6) and an uninfested larch tree of the same age located 2 meters from the irrigation source. The picture shows the current condition of a healthy tree that was damaged in 2013. He is healthy as he has not been infected by a pest from the tree next to him. It can be seen that these phenomena occurred more often during the experiments.

Fig. 3.6 Pine trees infested and not infested with the urban mustache beetle (Aeolecthec carta Colck).

200 trees of each age were studied in the region. As a result, it was found that older trees are more affected by urban mustache beetles than young trees. trees around highways, adult trees are damaged up to 40%, young trees are not damaged. Among the middle-aged trees, jiida trees were damaged to the highest degree.

It was observed that poplar trees began to be affected 3 years after planting. Infected poplar trees were mostly found around irrigation networks (see Figure 3.5). No damage was observed to young poplar trees on the roadsides (see Figure 3.7). Heavily infected poplar groves were observed until the main stems broke as a result of damage by the urban mustache beetle.

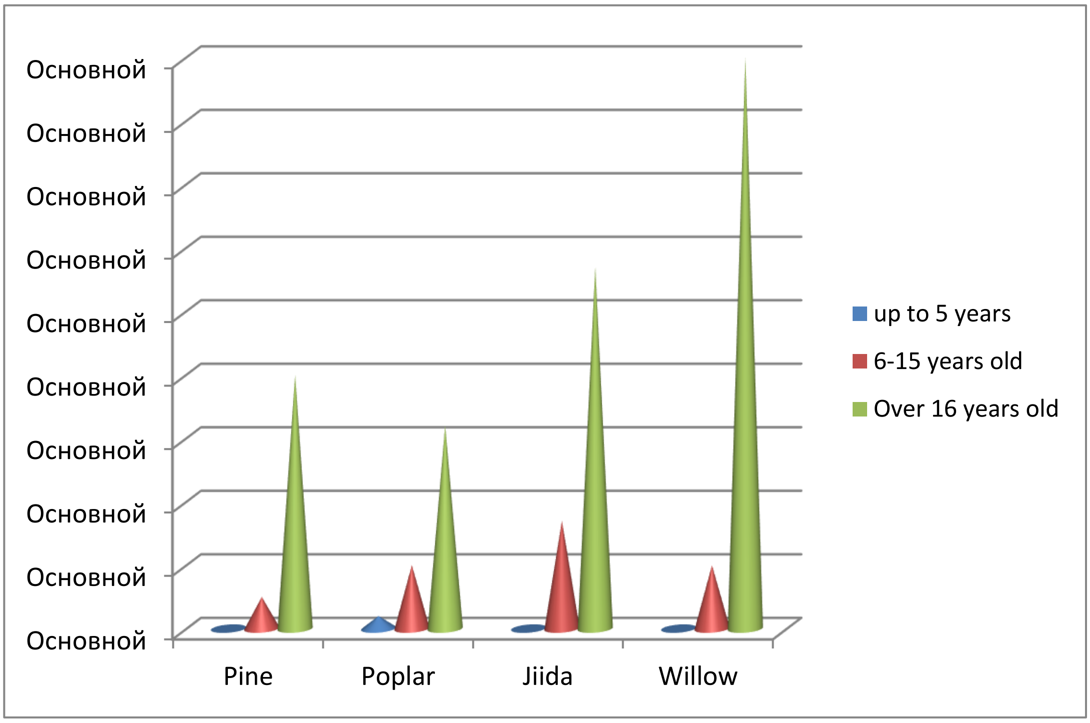


Figure 3.7. It is scenic around the traffic roads degree of infestation of trees by the urban mustache beetle (Aeolecthec carta Colck).

It was not observed that the young trees were damaged. Middle-aged trees were affected by 17%, and older trees were affected 3.5 times more than them.

In Khorezm region, almost all willow trees are cut once every 3-5 years as firewood or raw material. This can affect the immunity of trees. From 1 to 5 years after the transfer of willow trees, it was observed that the city was not affected by mustache beetles. It was found that 10% of middle-aged trees were infested, and 90% of older trees were infested with urban mustache beetles (see Figures 3.7-3.8). Since urban mustache beetles are more infested with willow trees after delimbing, adult infested willow trees form delimbed trees..

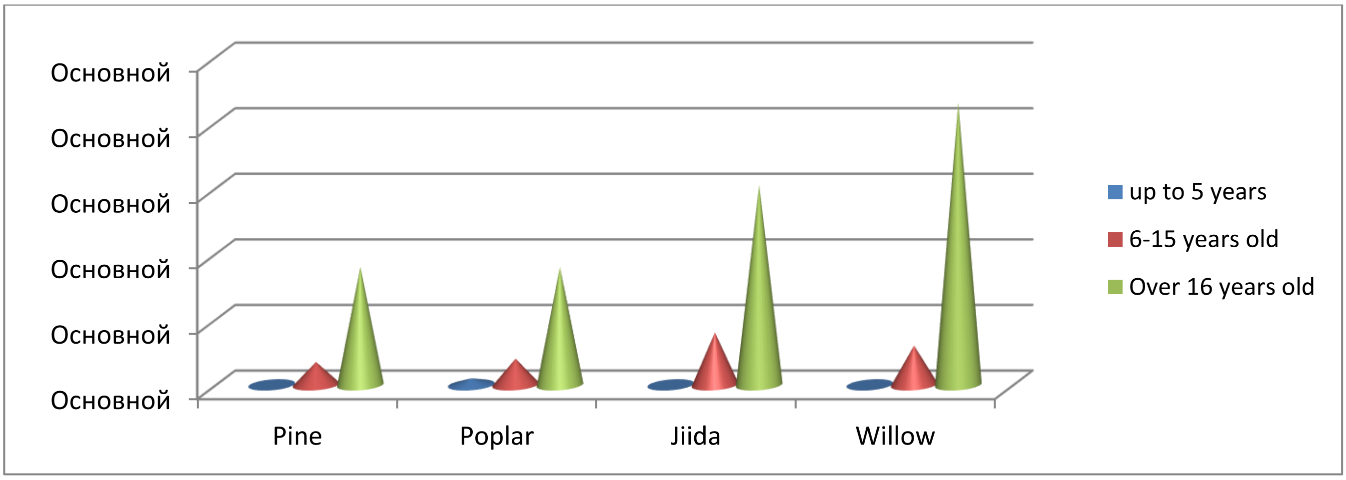


Figure 3.8. Damage level of ornamental trees planted around irrigation networks

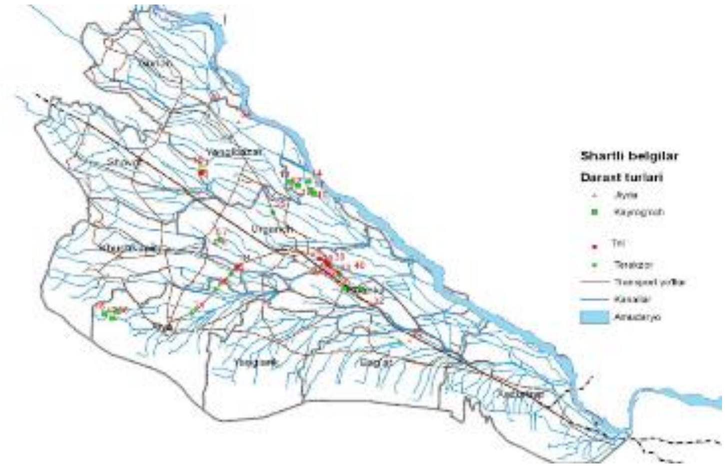


Figure 3.9. Distribution centers of urban mustached beetles (Aeolecthec carta Colck) in Khorezm region

On January 10, larch trees with nests of the moustached beetle were cut down and stored outdoors in special containers under closed conditions. (See Figures 3.10). They were constantly checked. After April 20, the cut pieces of wood were checked every day. From April 24, beetles began to emerge from the nests in tree cuttings. From April 29, they began to lay eggs. An average of two eggs was laid that day. On May 2, this figure doubled. The number of eggs decreased on May 6 and increased again on May 7. No spawning was observed in all variants on May 8.

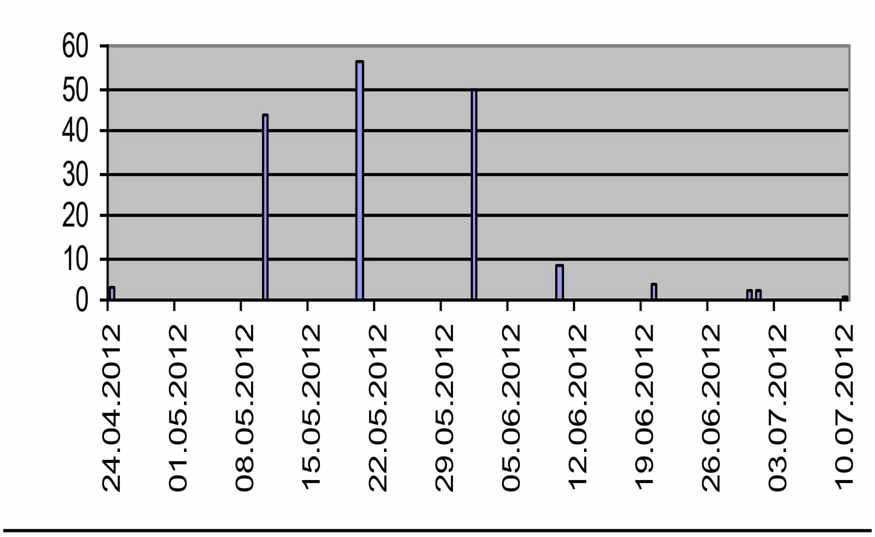


Figure 3.10. Flight of the urban mustached beetle (Aeolesthes sarta Solsk) in Khorezm region.

By May 10, the number of eggs increased to 6. In this order, the number of city mustached beetle eggs increased and decreased. The egg-laying process continued until May 23, when it was studied in closed containers. When studied in this order, it was observed that the minimum number of moustached beetles lays 86 eggs, 119 eggs on average, and 145 eggs in total. Determining the number of eggs and the period of egg laying is one of the important factors in the fight against them. We conducted experiments in natural climatic conditions. One female beetle gives birth to more than 100 pests. This information requires them to identify the foci of their spread. We have identified and developed digital maps of urban moustached beetle distribution centers in Khorezm region (see Figure 3.9)..

3.3.2 Distribution of the leaf-eater (Galerucella luteola Müll) in Khorezm region.

Galerucella leaf beetle (Galerucella luteola Müll) is a widespread pest throughout Uzbekistan in the region where the tree grows. It is widespread in the northern regions of Uzbekistan.

(A) Leaf-eating beetle

(B) Beetle larva

(C) Egg

(D) Mushroom

Figure 3.11. Developmental stages of the pine leaf-eating beetle (Galerucella luteola Müll).

It is more harmful to the alder plant that grows in residential areas and in the city. The pest undergoes a full transformational development. (See Fig. 3.11) The stage that causes damage to the plant is the larval stage [135; p. 213].

Larvae eat the soft part of the leaf and leave the lower epidermis and veins. In the years when the elm leaf-eater has multiplied, the elms in the city turn white. As a result, larch becomes more prone to damage by secondary pests. In 2012, pine trees growing in and around the city were severely damaged by leaf-eaters. For this reason, we conducted research on the development of the beetle. In 2012, pine leaf-eating beetles began to fly out from the second ten days of April. In the third ten days of April, they started to lay eggs. From the first ten days of May, their number of eggs decreased due to the large number of larvae and the number of newly laid eggs. Beetle eggs were found in trees until the second ten days of June.

Larvae began to appear on pine leaves from the first ten days of May. The number of larvae exceeded 100 and reached the maximum level in the second ten days of May. In the third ten days of May, their number decreased sharply. The decrease continued until the first ten days of June. From the second ten days of June, the number of larvae increased again. The number of larvae began to decrease from the first ten days of June. In the third ten days of June, larvae were not found on tree leaves..

It is necessary to study the reasons why the number of leaf-eating beetles (Galerucella luteola Müll) does not change on the leaves of pine trees from the third ten days of June. In our opinion, this phenomenon is related to the physiological state of the tree and changes in the number of entomophages in the tree..

As a result of phenological observations, the development of pine leaf-eating beetles was studied. From the second ten days of April, beetles began to leave the village. The activity of the beetles continued until the third ten days of May. From the third ten days of April, beetle eggs began to appear. The egg-laying period of beetles lasted until the second ten days of June. Larvae started appearing in the first ten days of May. Larvae have damaged pine trees by feeding on leaves from the first ten days of June. From the first ten days of June, mushrooms began to appear. From the third ten days of June, beetles started flying out of the mushrooms. Eggs of the second generation of beetles began to appear from the first ten days of June. Larvae of the second generation appear from the first ten days of June. Mushrooms of the second generation began to appear from the third ten days of June. Beetles started flying out from July. This event continued until the third ten days of July. Beetles started laying eggs from the second ten days of July. The egg-laying period of beetles lasted until the first of August. From the third ten days of July, mushrooms prepared for the summer began to appear. In the conditions of the Khorezm region, carp leaf-eating beetles gave 3 generations. In the conditions of Khorezm region, pine leaf-eating beetle can cause great damage to pine trees in years when the climate is favorable. Although this pest is less likely to completely kill pine trees, it creates favorable conditions for damage by secondary pests.

Mainly, the second generation causes heavy damage to pine trees. The level of damage by leaf-eating pests differs greatly from the level of damage to trees planted in open areas and in front of tall buildings. In 2019, we studied the differences between the damage rates of trees planted under 50 buildings and those planted outdoors.

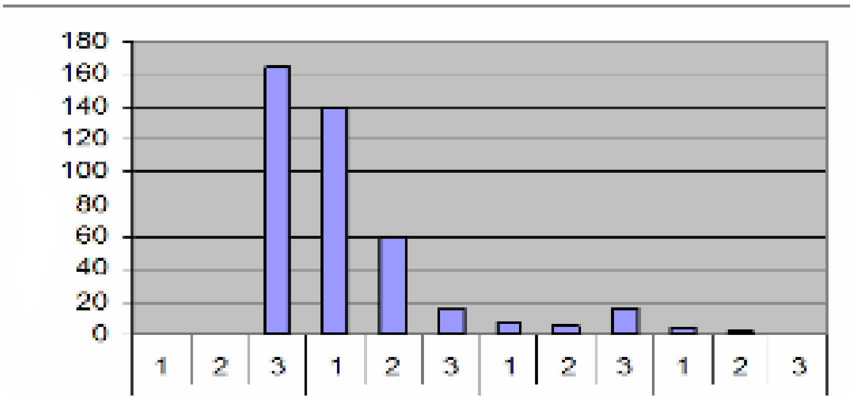


Figure 3.12. The average density of the number of eggs of pine leaf-eating beetle (Galerucella luteola Müll) in one tree in 2013.

In this case, the number of larvae per leaf in trees planted in open areas is 0.2, while in trees planted in front of tall buildings, the number of larvae per leaf can reach up to 5.

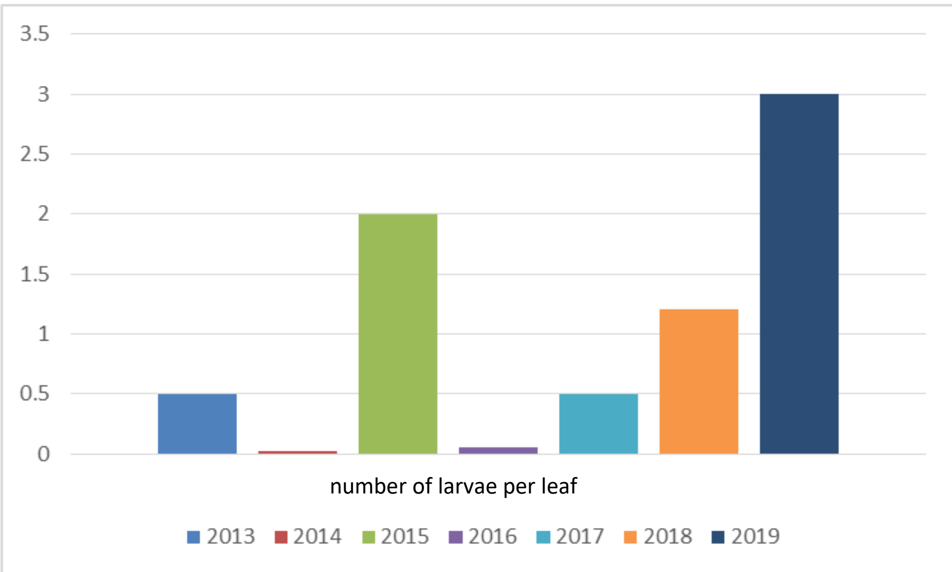


Figure 3.13. The average density of larvae of the pine leaf-eating beetle (Galerucella luteola Müll) per tree.

Leaf-eating beetles (Galerucella luteola Müll) decreased in 2014 and 2016, but their number increased in other years (see Figures 3.12-3.13). In 2019, it was observed that the number of this pest will be higher than in other years. These pest foci were formed in 2013 and their number is increasing.

3.3-table

Development phenological calendar of pine leaf-eating beetle (Galerucella luteola Müll).

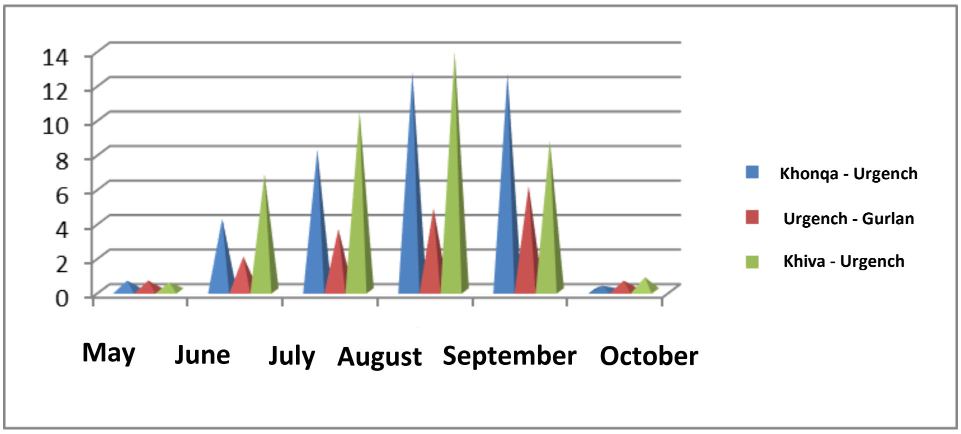
generation	Months																	
	April			May			June			July			August			September		
decades	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Beetles from the village		+	+ ○○	+ ○○ -	+ ○○ -	+ ○○	+ ○○ - 0	○○ - 0	0									
First generation							+ ○○ -	+ ○○ -	+ ○○ - 0	+ ○○ - 0	○○ - 0 + ○○	0 + ○○	○○					

+ a mature breed from the village, ○○ egg, - larvae, 0 - pupa, Failure to timely treat these pest foci can cause their number to increase from year to year. The phenological calendar of their development in regional conditions was studied (see Table 3.3). Warming of atmospheric air up to 40 degrees has a positive effect on the reproduction of this pest. It is considered appropriate to determine the location of trees from the khayragoch leaf spot and to carry out measures to combat the areas that tend to become hotspots as the temperature increases. After this pest infects all the trees in the city, it takes a lot of money to fight against it. To reduce these costs, it is necessary to form and implement a database based on GIS technology.

3.3.3 Distribution of the poplar sedge (Monosteira discoidalis Jak.) in Khorezm region

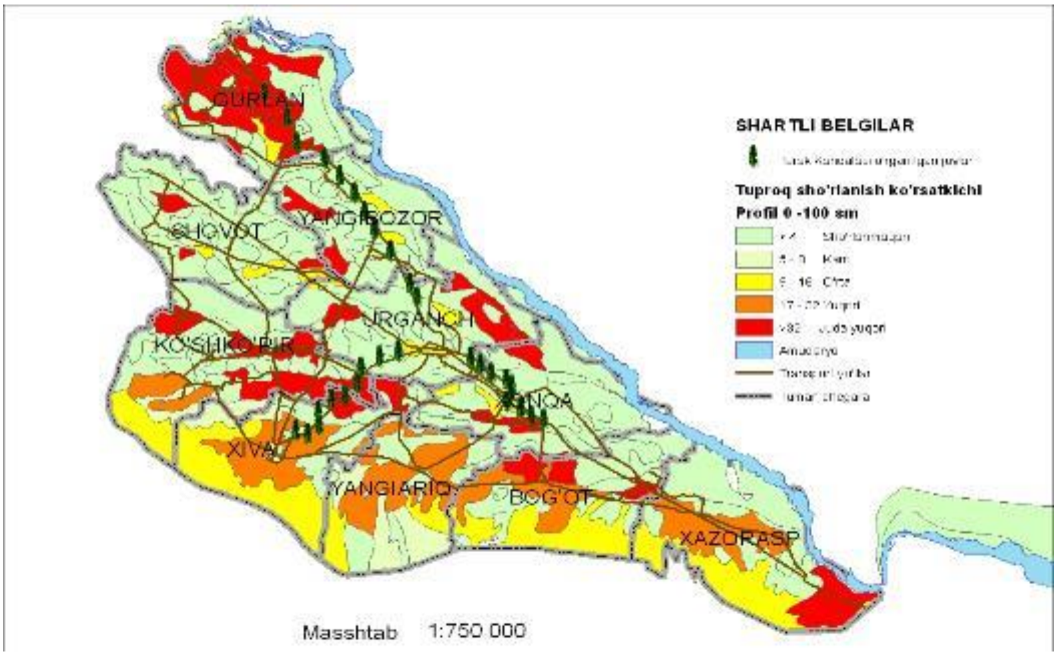
In the Khorezm region, which has a dry climate and is prone to desertification, the reduction of trees increases the tendency to desertification. More poplar trees are planted in the region. As this tree grows tall, it is more likely to trap sand and dust damage and prevent it from spreading far under the influence of the wind. Currently, poplars in the region are affected by pests and diseases.

In order to prevent poplars from being damaged by the poplar beetle (Monosteira discoidalis Jac.), it is necessary to monitor their spread and damage. In 2012-2013, in the region, poplars were damaged by many poplar beetles (Monosteira discoidalis Jak.). During this period, it was found in almost all poplar trees in the region. In the regional conditions, the damage of poplar trees by candals varies in large ranges without the same level. At the end of June, at the beginning of August, the leaves of poplar trees often dry up. We conducted research on the degree of damage to poplar trees planted on the sides of highways in Khorezm region. Researches were carried out in poplars on the sides of highways on Khanka-Urganch, Urganch-Gurlan, Urganch-Khiva routes in the order shown on the map (see Figure 3.14). A total of 10 trees were checked in each of the 4 trees in each tree stand, and the average number was rounded up and expressed as whole numbers.



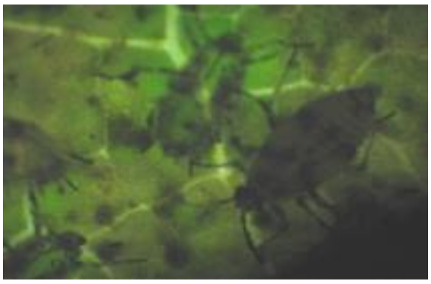
3.14- picture. The degree of damage to poplar trees by the poplar beetle (Monosteira discoidalis Jak.) in the Khorezm region (2012-2013)

A total of 100 trees were examined from 10 locations per direction. 300 trees were studied in 3 directions. The coordinates of the inspected areas were taken and mapped using GPS. The obtained data are presented on the map (see Figure 3.15). The soil salinity level and other conditions of the sampled areas were studied based on the GIS program. As a result, it was observed that the leaves of the infected poplars in the saline fields completely dried up in August. Candala (Monosteira discoidalis Jak.) is found as a fungus on poplar leaves. It was observed that they damage the leaves of cotton if they are planted around the cotton field. Candala (Monosteira discoidalis Jac.) larvae of different ages are found in poplar trees (see Fig. 3.16). Although they are less mobile, they can move from one tree to another and damage other trees. It was found that poplar trees in saline areas are more prone to damage by candals. Researches were conducted mainly on American poplars. These poplars grow quickly and can grow more than 10 meters in 5 years. Many were planted in Khorezm region in 2000-2005. In 2012-2013, most of them were damaged by handcuffs.



3.15- picture. Areas where research was conducted on the poplar skunk (Monosteira discoidalis Jak.).

3.16- picture. Poplar candala (Monosteira discoidalis Jac.)



3.17- picture. Poplar candala *(Monosteira discoidalis Jak.)* larvae

The average soil salinity level in the 0-100 cm layer was compared with long-term data. The database of the University of Bonn in Germany was used in Urganch State University. After the poplar beetle has severely infected the poplar leaves, they begin to turn yellow. The number of mites and larvae on yellowed leaves is less than on green leaves.

3.4-§. Environmental monitoring of cotton pests based on GIS technologies

3.4.1 Ecological monitoring of blind kandals (Miridae) based on GIS technologies

There are 12 types of cotton alfalfa agrocenosis. However, the characteristics of the species composition of the family, such as the pest fauna, have not been sufficiently studied.

Blind beetles are small to medium-sized insects. The whiskers are longer than the head, four-jointed, the second joint is somewhat longer, and the remaining ring-shaped joints are thinner in appearance. Normal eyes do not exist. It has four joints with a freely located trunk. The front part of the shoulder is wider than the middle part, its front edge is straight or slightly notched. Two pairs of wings are well developed. The claws are three-jointed, and the claws have protrusions. It closes the anterior edges of the posterior joints of the anterior abdominal joints. Eggs of blind candelabra are oblong in shape, white-yellow or light green in color with a shiny tint. Larvae are divided into three groups and develop according to 5 ages. Small larvae without wing growths (I-II age), medium ones with slightly noticeable growths (III age) and large larvae with well-developed wing beginnings (IV-V age) are distinguished. Larvae are similar to adults in the structure of their body and legs, but the number of joints in the body and legs and the ratio of the growths are very different from them. The harmful effects of blind shackles begin to be fully manifested already at the age of II and III.

Field beetle - Lygus pratensis L. is an omnivorous insect in the broad sense, damages various cultivated plants in MDX and Western European countries. The body size of adult kandals is slightly larger, 5.8-7.3 mm. The color of the body is yellowish green. This pest seriously damages fruit, grain, leguminous and sugar crops, especially alfalfa, beet, corn and tobacco, cotton, pumpkin, potato and other plants [163; p. 409].

Alfalfa clover - Adelphosoris lineolatus Goeze The shape of an adult clover is long and flat. The front part of the shoulder is bent and has two points, the shield has 2 stripes, it is colorless. The general color is brown-green with leathery outer edges. Some parts of the wing are black, and there is a large sword-like spot in the middle. The size of the bracelet reaches 7.5-9 mm. This pest damages alfalfa generative and vegetative buds. In this case, the growth of the stem and the dedifferentiation of the flowers are disturbed. 85-90% of the damaged flower buds are shed. At the beginning of the ripening period, damaged seeds die [157; p. 41--42].

It is observed that cotton infected with alfalfa weevil sheds its stalks, flowers, buds and pods and leaves turn yellow and dry. Damage to cotton by candela leads to a decrease in the intensity of respiration and the activity of oxidizing enzymes in the plant, which leads to a significant loss of yield, deterioration of fiber quality, shedding of the young crop element, and seed failure [148 p. 270].

As a result of biochemical and physiological analyzes in Azerbaijan, changes in the amount of monosaccharides, ascorbic acid, chlorophyll, and carotenoids were found in cotton leaves infected with alfalfa weevil. A. Sh. According to Hamraev, R. O. Ochilov, and others, a large amount of the stem infected with blind mites dries up, but it is distinguished by the presence of unshed buds, flowers and young buds. A yellow drop of cotton juice appears in the affected area of the flower, flower, and knot cysts, and later they dry in the air and turn black. The pest began to damage cotton from the flowering phase. Their small larvae are easy to catch. Adult larvae are very active and difficult to catch.

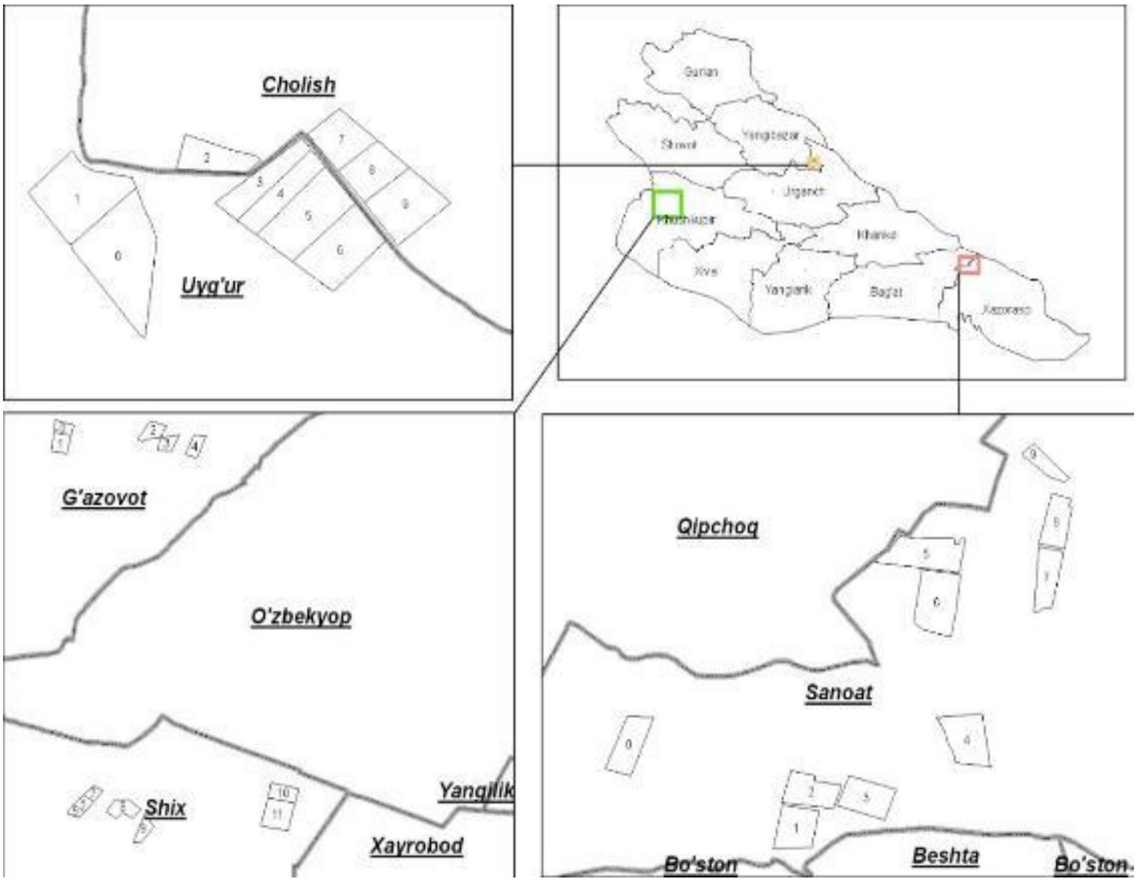
bed-bug

bed-bug larvea

3.18- racm. The period of development of bed-bug (Adelphocoris lineolatus Goeze).

This situation has a negative effect on the quality of cotton fiber and seeds. If the fruit nodes are damaged, they will not develop and will dry up. Black spots appear on damaged parts of the crop. Due to several punctures around the spots, they become larger and take on a different color. The cyst is deformed, sometimes it opens prematurely.

The distribution of blind kandals in the cotton fields of Khorezm region was studied. Research was conducted in the cotton fields of Khazorasp, Yangibazar, Koshkopir districts. A map of the experimental areas was drawn up (see Figures 3.18-3.19).



3.19- picture. GIS analysis of the study areas of the blind kandal (Adelphosoris lineolatus Goeze).

Fields where research was conducted were mapped using GPS coordinates. 10 fields were selected from the cotton fields of Khazorasp, Yangibazar, Koshkopir districts. Larvae were more common in their fields, and adult insects were less common. In the months of August and

September, the number of caterpillar larvae was high. In June and October, their number per plant was low and reached an average of 0.5-1.0 pieces. In the cotton fields of Khazorasp and Yangibozor districts, the average yield reached 7.4-10.6 pieces per plant. Many deformed bolls were found in the cotton fields. It was observed that their number varied depending on environmental conditions. This requires an in-depth study of the unique characteristics of each region.

3.4- table

Khazorasp district of Khorezm region is barren in the conditions of cotton fields (Adelphosoris lineolatus Goeze) and distribution of larvae (one seed per cotton plant).

№	Fields of experiment	June	july	August	September	October
1	0	-	3,0	5,2	6,8	1,6
2	1	1,2	4,2	5,0	8,8	-
3	2	-	4,0	4,2	8,2	-
4	3	-	-	6,0	9,2	2,4
5	4	1,0	3,2	4,2	7,2	-
6	5	1,2	4,4	6,6	13,2	1,4
7	6	-	4,0	6,2	11,8	1,2
8	7	2,4	6,2	9,8	12,8	2,4
9	8	2,2	4,4	9,0	14,2	2,6
10	9	2,2	5,0	11,2	14,6	1,6
	Average	1,02	3.8	6.7	10.6	1,8

3.5- table

Distribution of blind kandals (Adelphosoris lineolatus Goeze) and larvae in cotton fields of Koshkupir district, Khorezm region (individuals in 1 bush of cotton plant)

№	Fields of experiment	June	July	August	September	October
1	0	-	-	2,2	2,8	-
2	1	-	1,8	2,6	3,2	-
3	2	-	-	2,4	-	-
4	3	-	3,2	3,8	-	-
5	4	-	-	-	-	-
6	5	-	-	-	-	-
7	6	-	-	-	-	-
8	7	-	-	1,6	2,6	-
9	8	-	2,0	3	3,4	-
10	9	-	-	1	1	-
	Average	-	0.5	1.6	1.3	-

3.6- table

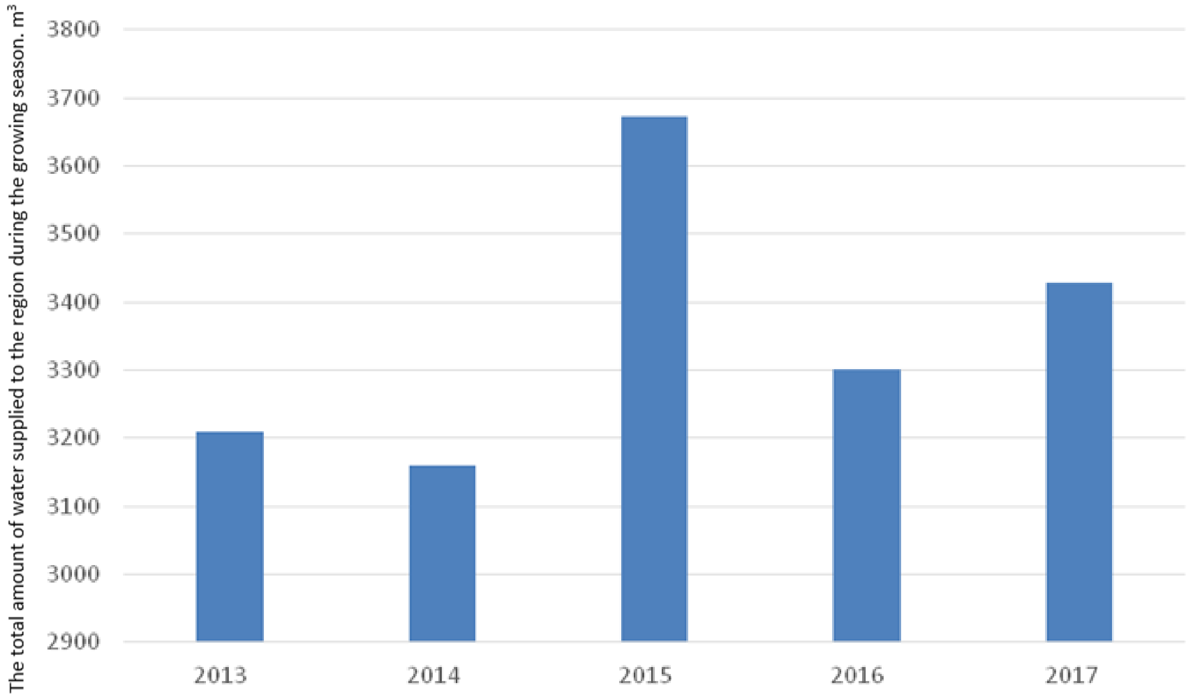
The distribution of blind caterpillars (Adelphosoris lineolatus Goeze) and larvae in cotton fields of Yangibozor district, Khorezm region (individuals in 1 cotton plant)

№	Fields of experiment	June	July	August	September	October
1	0	1	3,6	5,6	6,6	-
2	1	-	5,2	6,8	9,6	1,6
3	2	1,6	4,2	5,8	8,2	1,2
4	3	1,8	3,4	7,2	7,6	1,8
5	4	3,2	6,4	8,8	13,8	1,4
6	5	-	2,6	4,4	3,6	-
7	6	-	2,2	3,2	3,8	-
8	7	2,4	5,4	6,6	9,6	1,2
9	8	-	3,2	5,4	7,8	2
0	9	-	2,2	2,2	3,8	-
	Average	1	3.8	5.6	7.4	0.9

It can be seen that it is more common in Khazorasp and Yangibozor districts than in Koshkopir district (see tables 3.4-3.4-3.6). If we look at the studied areas and their distribution on the shown map, it can be seen that their number is more in the areas near the Amudarya than in the areas far from the river. The proximity of the river means that there are areas rich in various plants. Here there are favorable and nutrient-rich conditions for the development of kandals. That's why it was found that there is more spread of kandals in areas with a lot of weeds and close to alfalfa fields.

3.4.2 Environmental monitoring of cotton pests based on GIS technologies

We analyzed the distribution of cotton boll weevil (Heliothis armigera Hb) based on the amount of water used for irrigation in the region. In this case, it was observed that the increase in the amount of irrigation in the region depends on the increase in the total number of cotton tunnels (see Figure 3.20).



3.20- picture. The amount of irrigation water provided during the growing season of crops for Khorezm region.

The cotton bollworm (Heliothis armigera Hb) is a very dangerous pest that causes great damage to cotton growing in years when natural conditions are favorable for its development. According to the literature, tolerance to chemical poisons makes it difficult to fight against them. Therefore, it is important to determine in advance the increase of the cotton plant in cotton cultivation.

3.7- table

The number of eggs of cotton boll weevil (Heliothis armigera Hb) detected in the field (2013-2017).

Years	Khazorasp	Xonqa	Ko‘shko‘pir	Yangibozor	Average
	The number of eggs in one bush of cotton, pcs				
2013	0,3	0,5	0,3	1,0	0,525
2014	0,01	0,05	0,01	0,5	0,1425
2015	2,1	3	2,3	3,5	2,725
2016	0,01	0,05	0,01	0,5	0,1425
2017	0,5	1,0	0,5	1,5	0,875
Average	0,584	0,92	0,624	1,4	0,74125

We made a comparative analysis of the years of cotton growth in the conditions of Khorezm region with the amount of total irrigation water allocated to Khorezm region, taken from the accounts of the "Amudaryochapqirgok" irrigation systems basin management (see table 3.7). In 2013, 3,209,062 million cubic meters of water were allocated to plants during the growing season. 3160.604 million in 2014. cubic meters, 3672.85 million in 2015. cubic meters, 3301.987 million in 2016. cubic meters, 3427.287 million in 2017. cubic meter of water is given. In accordance with those years, it was observed that the development of the cotton tunnel was different in the cotton fields of the region. The maximum number of pest larvae found in the experimental fields was averaged for the fields. In 2013, on average, up to 0.52 larvae were found per plant in cotton fields, 0.14 in 2014, 5.72 in 2015, 0.14 in 2016, and 0.74 in 2017 (see Table 3.6). In 2013, up to 1 cotton bollworm larvae was found in 1 plant in Yangibozor district. The lowest amount was 0.3 units in Koshkopir district. Khanka district took the next place in terms of cotton tunnel development. It was 0.5 pieces in 1 bush of cotton. In 2014, on average, 1 bush of cotton corresponded to 0.14 pieces in the inspected fields. This year, in the cotton fields of Yangibozor district, the average number of cotton seeds was 0.5 per bushel, which was higher than in other studied districts. In 2014, compared to 2013, it was observed that the occurrence of cotton nightshade in the fields decreased. In 2015, compared to other years, the number of cotton bollworm larvae in experimental fields was very high - on average 2.75 pieces per 1 bush of cotton. In Yangibozor district, these indicators are high: 1 bush cotton 3; It made 05 units. It can be seen that the amount of water irrigated during the vegetation period is the highest compared to other studied years. In 2016, the average number of cotton bollworm larvae decreased. In 2017, the number of cotton nets decreased by an average of 19 times compared to the previous year. In these years, it was observed that the number of cotton buds in Khanka and Yangibozor districts is higher than in other districts. In the conditions of Khorezm region, the development of the cotton field in 2013-2017 increased with the increase of the total amount of water allocated to the region during the growing season. This shows that the amount of irrigation water allocated to the region is an indicator of the development of the cotton sector.

In the conditions of the Khorezm region, the flight of the cotton tunlami butterflies is observed in the first decade of April and lasts until the third decade of May. During this period, the soil temperature reaches 100 C in a 10-centimeter deep layer of the soil. The flight period of the first generation butterflies can last until the second generation butterflies fly. That is why the flight period of cotton night butterflies lasts until October. In one season, the cotton plant gave three to four generations. It is observed that it remains undeveloped until the end of the fourth generation. It was found that adult butterflies fell into pheromone traps in the second and third ten days of April. In the second ten days of May, 2-3 cotton bollworm eggs were found on the leaves of cotton and tomato plants. From the third ten days of May, cotton bollworm larvae were found in the cotton fields. From the second ten days of June, mushrooms were found among the soil layers. Larvae began to appear in some fields from the third ten days of June. In June, butterflies were found among the soil layer, and it was observed that the number of butterflies increased from the third ten days of June. From the first ten days of August, eggs began to appear in the cotton fields. Larvae began to appear in the second ten days of August. In the first ten days of September, it was observed that the number of mushrooms increased among the soil layers.

An average of 12 flowers of 65 cones were examined to study the damage of the first generation of tunlam to the fruit organs of cotton. It was found that 12 pods and 2 flower organs were damaged. This means that 18% of panicles and 16% of flower organs are affected (see Table 3.8). 58 bolls, 25 flowers, and 10 bolls were examined to study the degree of damage to the cotton organs of the second generation of the cotton bollworm. It was observed that 16 pods, 5 flowers, and 1 pod were damaged. This showed that 27.5% pods, 20% flowers and 10% pods were affected.

3.8- table

Damage of the cotton boll weevil (Heliothis armigera Hb) during the season by generations (Davron farm, Khiva district).

Generation	Generative organs of cotton	The number of studied crop elements	Number of damaged crop elements
I generation	Shona	65	12
	Flower	12	2
II generation	Shona	58	16
	Flower	25	5
	Boll	10	1
III generation	Shona	25	5
	Flower	50	15
	Boll	160	12

25 bolls, 50 flowers, and 160 bolls were observed to study the level of damage to cotton crop organs by the third generation of the cotton bollworm. It was found that 5 pods, 15 flowers and 12 pods were damaged. This shows that 20% of the pods, 30% of the flowers, and 7.5% of the pods are damaged.

Butterflies that have flown out in the spring feed on the nectar of flowers of several plants: ephemerals, ephemeroids, perennial plants, members of the legume family. Butterflies feed on the nectar of cotton flowers in the evening.

Alfalfa and many other plants can feed on nectar. Butterflies lay one or 2-3 eggs on leaves and generative organs. The features of plant selection for egg-laying of 2nd generation butterflies of the cotton tunlam were studied (see table 3.9).

3.9- table

Selection of plants for egg-laying of the 2nd generation butterflies of the cotton weevil (Heliothis armigera Hb) (Davron farm, Khiva district)

Plant	Number of plants (units)	Development phase of plants	Number of butterflies (pieces)	Number of eggs (units)
Corn	5	The period of formation of shoots	9	120
Cotton	5	Period of worship	9	806

According to experimental data, the number of eggs laid by butterflies is higher in cotton than in corn. In fields planted with cotton, middle-aged larvae began to appear in fields planted with adult corn. The ability to choose, this characteristic characteristic of the larvae of the cotton worm, begins to manifest itself with the successive changes in its nutrition. According to plant phenology, cotton bollworm larvae choose a specific part of the plant at different ages.

Having received information about the development of the cotton weevil (Heliothis armigera Hb) in Khorezm region, we conducted research on the distribution of the weevil in cotton fields using GIS technology. The coordinates of the studied fields were obtained using a GPS navigator and analyzed on the basis of GIS software. The results of the obtained data (see pictures 3.18-3.26) are presented on the maps.

Fields shown for the experiment are represented by red dots. Experiments were conducted in Urganch and Bogot districts. According to the received information, the spread of the cotton bollworm in the cotton fields of Urganch district, i.e. the number of cotton bushes with cotton bollworm larvae and eggs on June 5, increased from 61 to 76. and this indicator was 74-100 as of August 5 (see Table 4.10).

Based on the data collected from 6 points with the help of a GPS navigator, it was possible to express the amount of cotton in the studied area through tables, and the electronic form of this data was based on GIS technology. The possibility of analysis was created on the basis of information about

3.10- table

Data collected using a GPS navigator on the distribution of cotton bollworm (Heliothis armigera Hb) in the cotton fields of Urganch district (2013).

№№	GPS	Number of bushes with cotton bollworm larvae and eggs % (June 5)	№	GPS	The number of bushes with cotton bollworm larvae and eggs in % (August 5)
1.	001	76	1.	007	85
2	002	65	2	008	74
3	003	79	3	009	87
4	004	77	4	010	83

5	005	82	5	011	100
6	006	61	6	012	74
		Average 73.33			Average 83,83

Similarly, the data collected using the GPS navigator on the distribution of cotton weed in the cotton fields of Bogot district can be analyzed using GIS data or both studied districts. Complete data were collected for cross-comparison, prediction of cotton bollworm development and timely control measures. As can be seen from the data presented in the tables, the spread of the cotton bollworm in the cotton fields of Urganch district, that is, the number of cotton bolls with cotton bollworm larvae and eggs on June 5 on average, it was 73.33, while this indicator was 23.22 in Bogot district, and the density of cotton in the cotton fields of Urganch district is much higher than in Bogot district. It was noted that (see Table 3.11).

By the end of the season, that is, on August 5, the number of plants affected by the cotton weevil in the cotton fields of Urganch district increased to 83.83, while in the farms of Bogot district, The average number of plants found in the tunnel reached 25.22. The analysis of the received data means that the number of larvae and eggs of the cotton bollworm in the studied area of Urganch district, that is, the density of the pest, is 3.1 times as of June 2, and 3.2 times as of August 5, as compared to that in Bogot district. showed that there are many.

3.11- table.

Information on the distribution of the cotton boll weevil (Heliothis armigera Hb) in the cotton fields of Bogot district, collected using a GPS navigator (2013).

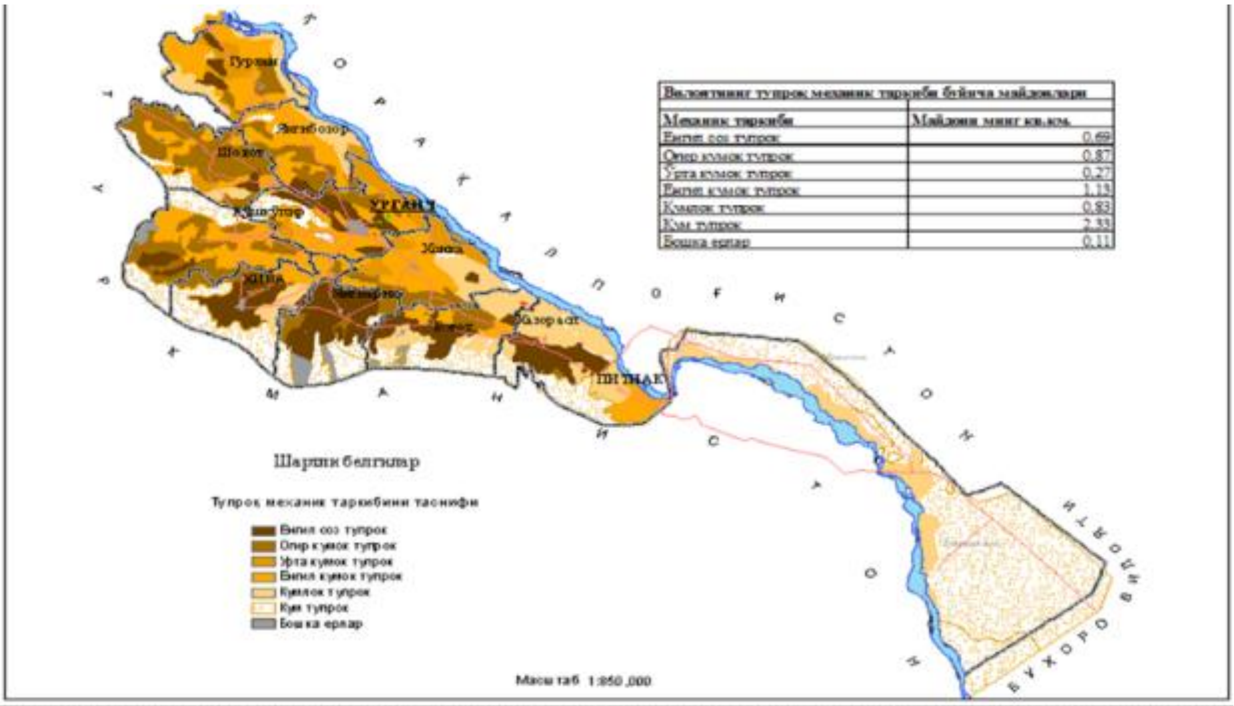
№	GPS number	Number of bushes with cotton bollworm larvae and eggs % (June 5)	№	GPS number	The number of bushes with cotton bollworm larvae and eggs in % (August 5)
1	102	2	1	102	5
2	103	46	2	103	48
3	104	11	3	104	24
4	105	8	4	105	15
5	030	21	5	030	47

6	031	37	6	031	10
7	032	18	7	032	15
8	041	35	8	041	28
9	043	32	9	043	35
		Average 23,22			Average 25,22

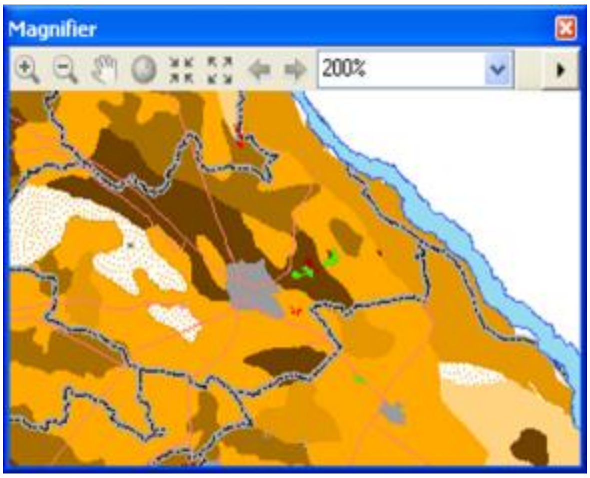
Data collected using a GPS navigator on the distribution and density of Goza tunnel in Bogot and Urganch districts, soil mechanical composition, groundwater level depth, groundwater mineralization of Khorezm region in the GIS laboratory of Urganch State University were analyzed with the database of indicators (Appendix 9). Even when it is suspected that the problem of the object under study is obtained on a small scale or the reliability of the data does not fully meet the requirements, using the opportunities of a methodologically correct approach, the spread of cotton tunnels in the territory of both districts under study and for the first time, an attempt was made to reveal the laws of density distribution through GIS technology.

In order to determine the reasons for the distribution and density of cotton tunnels in the territories of both districts under study, the data collected about the cotton tunnels using a GPS navigator, the depth of the groundwater level of the region, soil mechanical composition, groundwater mineralization indicators were analyzed with the GIS database. The obtained data are given in the pictures. In the fields of Bogot and Urganch districts, the distribution and density of cotton tundra was studied by comparing the mechanical composition of the soil in the studied fields according to the degree of damage. Mechanical composition is the ratio of particles of different sizes in the soil. It is accepted that as the amount of sand particles in the soil increases, its mechanical composition becomes lighter, and with the increase of small muddy particles in the soil, the mechanical composition also becomes heavier. In sandy, loamy, sand and clay soils, the same properties and regime do not occur. Sandy soils do not have a large water capacity, they are a type with good water permeability and low upwelling of water. Sandy soils dry out faster than loamy soils. This may not allow moisture to increase in the cotton fields. Loamy soils have a very poor water permeability, a high level of water seepage through capillary tubes from the bottom up. In addition, sandy soils have a very large water capacity. Soils with two different mechanical compositions have their own air, water and thermal regimes. Using this thermal regime, the farmer managers arranged to sow cotton later because the sandy lands started to heat up earlier and the sod lands started to heat up later. Biological processes take place more actively in soils with a good mechanical composition due to the fact that moisture is kept longer than in sandy soils. As a result of active biological processes, carbon dioxide gas is likely to be produced. A large production of this gas affects the microclimate. This affects the development of insects in that field. In the literature review chapter, the effect of rainfall on the death of cotton bollworm is shown. Soils with a heavy mechanical composition are difficult to soften under the influence of heavy rains. This can reduce the death of cotton buds in the form of a sponge. Sandy, loamy soils, under the influence of heavy rainfall, turbidity penetrates into the pores and causes the pores to become dense and they may die. Lands are plowed as agrotechnical measures against the cotton worm. There is little chance of formation of lumps in the soil when the sand is plowed. Large lumps are formed in loamy soils. There is a high probability that the cells formed by the fungi will remain in large lumps and not die. In the experiments, there is information about the low damage of cotton by the cotton bollworm in the fields with the mechanical composition of light loam and, on the contrary, the relatively low damage of cotton with the bollworm in the light and medium loam soils. collected.

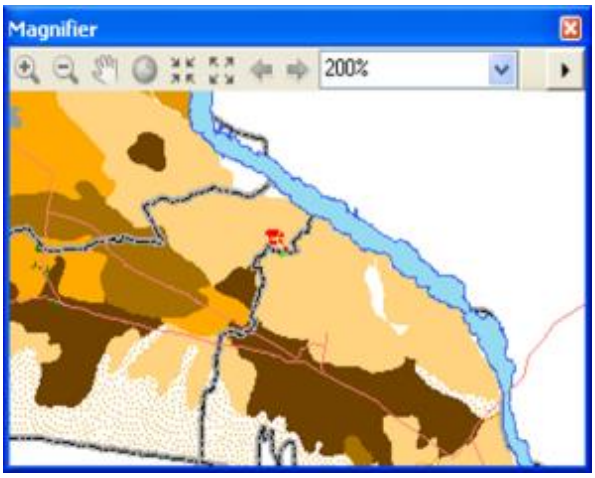
It is also known from the published scientific literature on the bioecology of the cotton bollworm that the cotton bollworm mainly damages the cotton fields with high humidity. That is why cotton wool is widespread in temperate and subtropical regions. In Central Asia, cotton wool is found everywhere. However, its quantity and damage are different in different soil and climate zones. Most of the regions of Surkhandarya, Fergana and Andijan are constantly affected. It is known to all experts that after a number of irrigation facilities were put into operation, this pest began to multiply in the Bukhara region, in the south-eastern zone of the Syrdarya regions, and in the Namangan and Kashkadarya regions.



3.21- picture. Mechanical composition of soils of Khorezm region.



3.22-picture. Comparison of the spread of cotton tunlama in the fields of Urganch district with indicators of soil mechanical composition



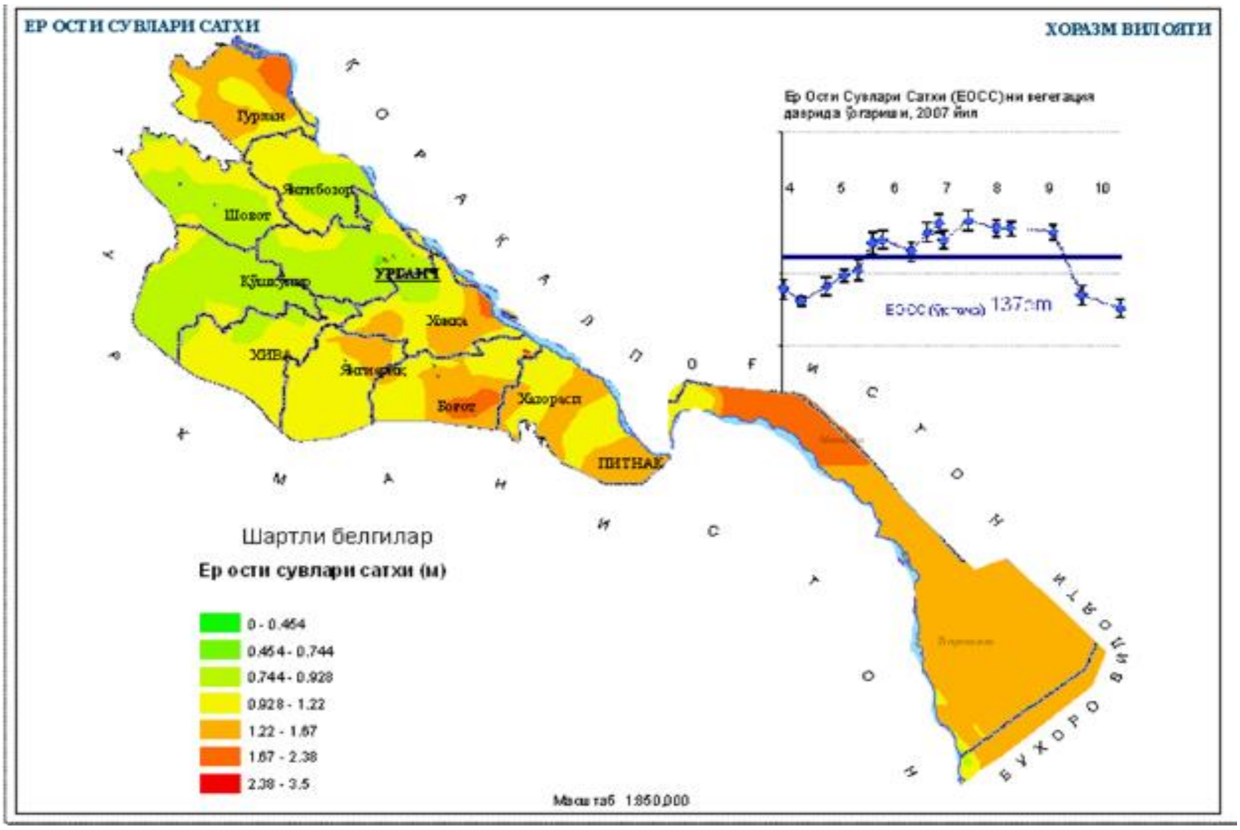
3.23-picture. Comparison of the distribution of cotton tunlami in the fields of Bogot district with the indicators of soil mechanical composition

As a result of the conducted research, the data on the distribution, density and similar factors that increase its damage in the fields of Urganch and Bogot districts of Khorezm region were determined with the help of a GPS navigator and stored in the GIS database. As a result of the study, for the first time, it was found out that there are mutual laws between the soil and water quantity indicators of the cotton field (see Figs. 3.21-323). A full study of these factors and their application to production will allow to improve the fight against the cotton bollworm, which causes great economic damage to the raw material base of the cotton industry of our Republic.

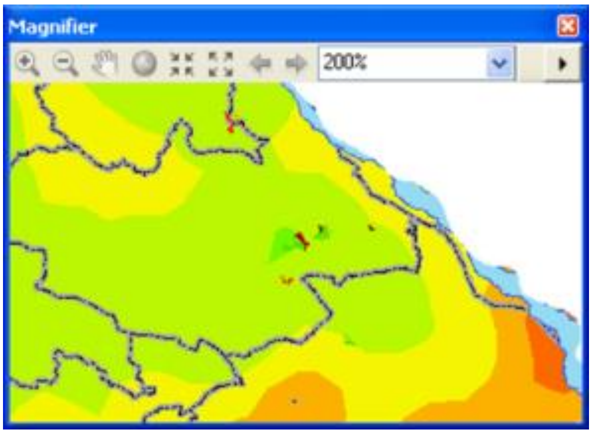
There is a greater possibility of evaporation of more water through capillaries on the surface of the ground than in sandy soils in soils with a low mechanical composition through underground water. Evaporation of a large amount of underground water through capillaries affects the field climate. An increase in relative humidity in the composition of the field air improves the mating quality and increases the pollination of cottontail butterflies, as shown in the literature review chapter. That is why it is important to study the level of underground water in determining the foci of occurrence of cotton tunnel.

GIS maps were used to determine whether the Ghoza tunnel is related to the depth of the groundwater table. The data collected with the help of a GPS navigator were plotted on the corresponding maps according to the coordinates and analyzed. When comparing the level of groundwater in heavily damaged cotton fields in Urganch district and less damaged cotton fields in Bogot district, it was found that the groundwater level in heavily damaged areas in Urganch district was close (up to 0.5-0.7 m), while in Bogot district It was found that it is quite deep (from 0.9 to 1.6 m.) (see pictures 324-326). The level of underground water in Khorezm region may vary depending on the type of crop and agrotechnical measures applied to neighboring fields. The level of underground water was studied during the Shonalash period.

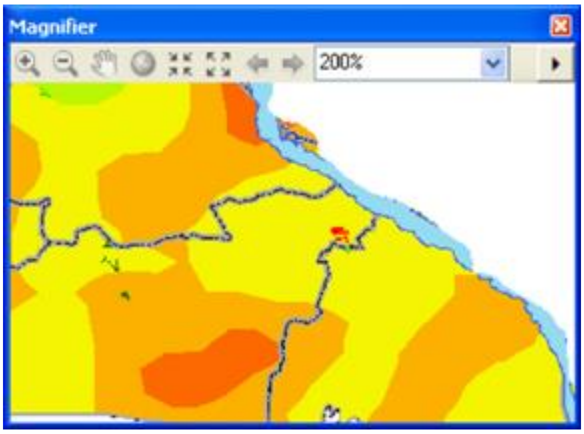
In addition, mineralization of underground water in the fields heavily and lightly affected by cotton tunlam was compared and studied in the studied districts based on GIS programs. It was observed that the mineralization of underground water in these areas does not differ sharply (it varies from 1.91 to 2.82 g/l;).



3.24- picture. Depth of underground water in the conditions of Khorezm region

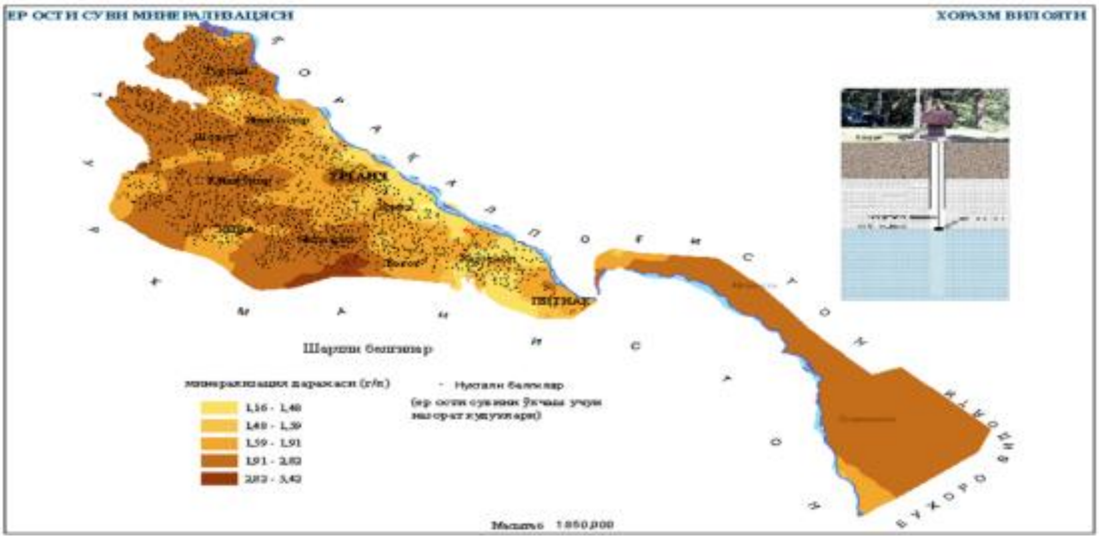


3.25- picture. Comparison of the spread of cotton tundra in the fields of Urganch district with the indicators of the depth of the underground water level.



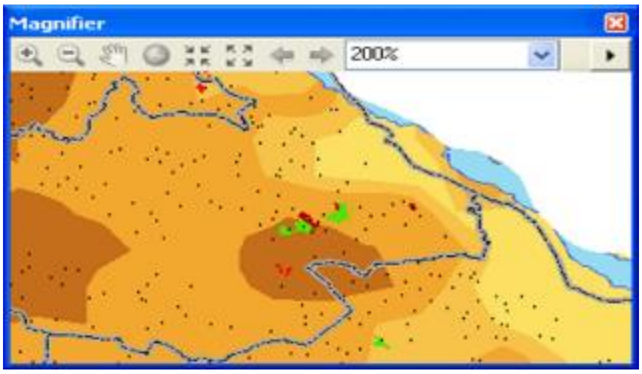
3.26- picture. Comparison of the distribution of cotton bollworm in the fields of Bogot district with the indicators of the depth of the underground water level.

In 6 points of Urganch district, the fields with the most spread of cotton bollworm were found to be less affected by cotton bollworm at 9 points in Bogot district. High mineralization of underground water increases salinization processes in the field. It has been shown that in cotton fields, the height of cotton is reduced in saline fields.

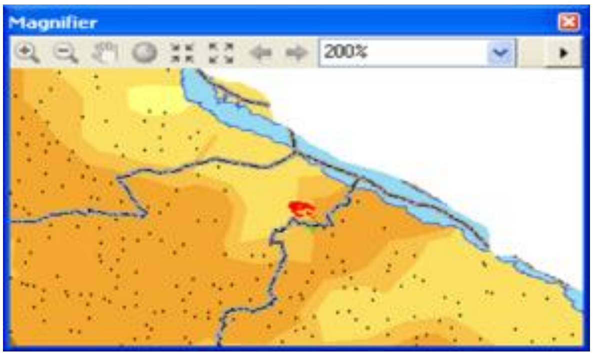


3.27- picture. Mineralization of underground water in Khorezm region

Areas where cotton wool is spread were compared with indicators of groundwater mineralization (see Figures 3.27-3.29). According to the information of most Uzbek researchers, the low height of the plant causes inconvenience to the cotton fields, where the boll development is delayed.



3.28- picture. Comparison of the distribution of cotton bollworm in the fields of Urganch district with indicators of groundwater mineralization.

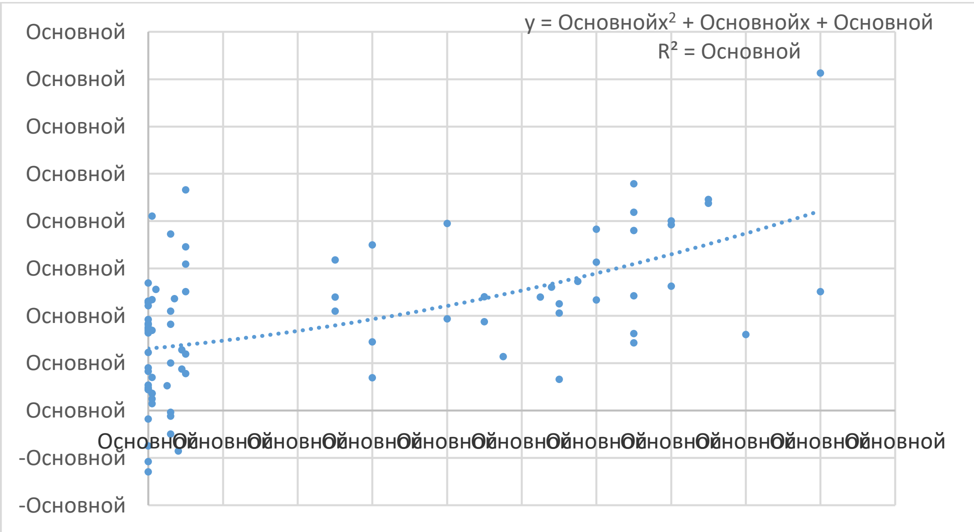


3.29- picture. Comparison of the distribution of cotton tunlami in Bogot district with indicators of underground water mineralization.

The location of the heavily damaged and less damaged field was analyzed by satellite survey of the earth. It was found that heavily damaged areas in Urganch district and less damaged areas in Bogot district are somewhat close to irrigation networks. The proximity of a large (5 hectares) rice field to heavily damaged cotton fields. It can be seen that the less affected cotton fields in Bogot district are close to small

(0.5-1 hectare) rice fields. In the studied fields, the mechanical composition of the soil was compared and studied according to the degree of damage. In this case, it was observed that in the majority of less affected fields, soils with a mechanical composition of light sand, and in heavily damaged fields, light and medium sand soils were distributed.

In addition, on the basis of GIS computer programs, the groundwater mineralization of fields heavily and lightly damaged by cotton tunnels was compared and studied. It was observed that the mineralization of underground water does not differ strongly in the areas where cotton tundra is the least common. (varies from 1.91 to 2.82 g/liter).

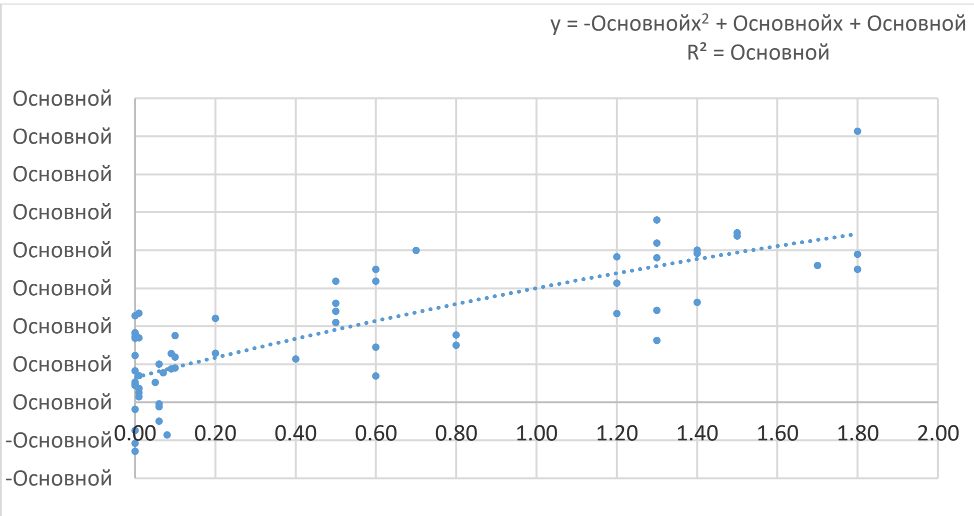


3.30- picture. The relationship between the number of eggs of cotton boll weevil (Heliothis armigera Hb) and NDVI

When the level of underground water was studied by comparing heavily damaged cotton fields in Urganch district and less damaged cotton fields in Bogot district, it was found that heavily damaged areas in Urganch district were close to groundwater (from 0.5 to 0.7 m).

According to the results of many years of research by scientists, the cotton moth butterfly lays more eggs in overgrown fields. Healthy plants grow in these fields due to high humidity. Butterflies try to lay eggs on healthy plants. The correlation of these factors with the number of eggs laid by the cotton boll weevil was studied (see Fig. 3.30), the results of the correlation analysis of the number of eggs in the field and the NDVI index (vegetation biomass in the field) are presented. In this case, the correlation between the high biomass and the increase of eggs of the cotton moth was 30.5%. This suggests the need to study the effects of other factors in fields where female cottontails lay large numbers of eggs. This includes the factors analyzed above. In particular, the heavy mechanical composition of the soil theoretically increases the possibility of plants using groundwater in these fields. The water capacity of these soils is higher than sandy soils. The high water capacity causes the cotton to grow taller and increase the air humidity in the field. Agar soils have a light mechanical composition or a decrease in the amount of silt and clay particles in the composition leads to a decrease in water capacity. In terms of the effectiveness of agrotechnical control measures, large lumps are formed after plowing in soils with heavy mechanical composition. There is a high probability that cotton bolls will be preserved in these pieces without dying.

The biomass of cotton in saline soils is low and does not allow moisture to increase in the air in the field, in such areas the probability of laying many eggs of the cotton moth is very low. Taking all these factors into account, a diffuse analysis was performed (see Figure 3.31). It is important to constantly enrich the GIS database in order to more accurately predict the areas with a high probability of the spread of cotton wool. Indian scientists have found out that the cotton moth lays more eggs in fields with high atmospheric humidity.



3.31- picture. Correlation of indicators of agro-ecological factors in the field with the number of eggs of the cotton weevil (Heliothis armigera Hb).

We analyzed the indicators of agro-ecological factors available in the GIS database about the fields of Khorezm region (see Table 3.12).

3.12– table.

Classification according to the level of agroecological factors (reworked form of the classification developed by M. Sultanov)

№	Factors	Classification				
		Very convenient	Comfortable	Average	Low	Inconvenient
1.	Channel density, m/ha^{-1}	>8	8-6	6-4	4-2	<2
2.	Drainage density, m/ha $^{-1}$	>40	40-30	30-20	20-10	<10
3.	Underground water level, m	<0.5	0.5-1	1.0-1.5	1.5-2	>2.0
4.	Groundwater mineralization, g/l	<1.0	1-3	3.0-5.0	5-10	>10.0
5.	Soil mechanical composition, amount of particles, %	>60.0	45	30	20	10.0
6.	Soil quality, score	>70.0	70-60	60-50	50-40	<40
7.	NDVI, plant biomass	>0.7	0.7-0.5	0.5-0.4	0.4-0.3	<0.3

In 2016-2017, M. Sultanov conducted research on the identification of salinity-prone areas of the soil based on GIS technologies and classified the areas based on agro-ecological factors. We developed a modification of this classification method and conducted research to identify areas with a high susceptibility to damage by the cotton bollworm. Based on the collected data, agroecological factors were classified (see Table 3.13). Environmental factors can directly and indirectly affect the spread of cotton blight in the field. For example, if plant biomass has a direct effect, the level of underground water and salinity have an indirect effect. It is observed that there is high humidity in the areas near the underground water, and the growth of cotton. The developed classification of agroecological factors includes the factors that increase the moisture content and increase the biomass. In very comfortable and favorable areas, there is a high probability of continuous development of cotton nightshade. In Khorezm region, 85 fields were studied and their dependence on agro-ecological factors was analyzed.

3.13- table.

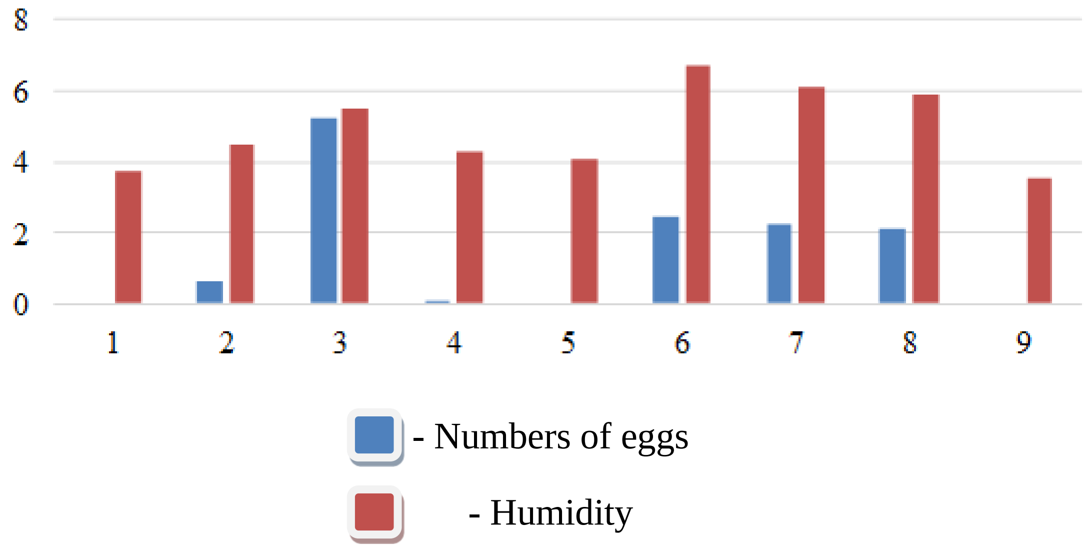
Indicators of agroecological factors and distribution of cotton boll weevil (Heliothis armigera Hb) eggs.

№	Factors	Classification									
		Very convenient		Comfortable		Average		Low		Inconvenient	
		t	z	t	z	t	z	t	z	t	z
1.	The average number of eggs of cotton nightshade (in bush/piece)	8	1,51	12	0,71	20	0,5	20	0,1	25	0,03
2.	Number of affected fields	8	8	12	10	20	6	20	2	25	0

t-number of inspected fields z- infected field

In the Khorezm region, there are very few areas with an underground water level of less than 0.5 meters. This period corresponds to the period of ginning and picking of cotton (the second and third ten days of June). This period is the time for planting rice and irrigating cotton in the areas freed from wheat (see Table 3.13). In the fields where the influence of agro-ecological factors was studied, the fields with a very favorable and favorable cotton bed laid a large number of eggs. It was observed that fewer eggs were laid in areas with average and low comfort level. It is very common in areas with a high slope. It was observed that the cotton moth did not lay eggs in unfavorable areas.

Hygrometric indicators were analyzed using small devices in the farms owned by "Sarapayon bioservis" of Khanka district, "Davron" of Khiva district, and "Rozzoq" farm of Khanka district. In this, the dependence of the amount of cotton bollworm eggs on the relative humidity of the atmospheric air in the field was studied. (See Figure 3.32). It was observed that the cotton moth lays its eggs in areas with high humidity.



3.32- picture. Atmospheric air humidity of the field (10 times reduced) and the number of eggs of the cotton boll weevil (Heliothis armigera Hb) per plant (2017).

Data on the effect of temperature and humidity on the spread of cotton wool are being used to predict. Adopted prediction system was implemented on the basis of existing weather stations in the region.

In the era of advanced science and technology, it is necessary to put new scientific achievements into practice in order to collect data in the forecasting system. During the period when the current forecasting system was developed, weather stations were complexly structured and placed on a large area.

Currently, small weather stations of various shapes have been created. There are big errors in the interpolation of the data about the areas between the major meteorological stations. Due to the low cost and small size of the weather stations, they can be placed densely (for example, 1 per 10 hectares), which allows less errors when interpolating the data between the weather stations. We installed 3 small weather stations in the fields owned by "Sarapayon Bioservice" of Khanka district, in the fields of "Davron" farm in Khiva district, and in the fields of "Bakhrom Makhfuza" farm in Gurlan district (10 attachments). In the results, it was found that not all the dalalas have the same hygrometric index. We know that a specific set of effective temperatures (5500 C) has been developed for the cotton bud to take off at a certain temperature and pass through other phases of its development. So cotton nightshade butterflies fly first in fields with high temperature. As shown in the literature review chapter, it lays its eggs in areas with high humidity. The high humidity depends on the biomass of the crop in the field or whether it is overgrown. In tall cotton fields, air humidity can be high. The indicator of high humidity in cotton fields also depends on the agrotechnics applied to the crops of the neighboring field and the studied field and other factors. In the examined cotton fields, the NDVI index, which is considered as an increasing indicator equivalent to crop biomass, was determined (Appendix 11), and the dependence of this indicator on the humidity of the atmospheric air in the field and the number of cotton bollworm larvae was studied. From May to September, the average values of the maximum daily air humidity and the average daily indicator were studied. The change in air temperature was studied in the same order. The temperature drop and the periods of the minimum temperature were analyzed. According to the results of the analysis, the relative humidity of the atmospheric air changes according to the daily temperature trend. Although the moisture content is not very high, the diagram shows that the number of pest eggs is high. Cotton biomass index is high in this field.

Conclusions on Chapter III

1. Based on the research work, maps representing the foci of pest distribution have been developed. Their use in the fight against pests of agricultural crops is justified.
2. In order to determine the susceptibility of the cotton fields to the growth of the cotton weevil, the dependence of plant biomass was determined. It has been shown that the correlation with the biomass of plants in the field obtained by the Landsat satellite is more than 30%.
3. Agro-ecological factors were analyzed in the cotton fields to determine the areas prone to the increase of the cotton boll weevil, and they were evaluated according to the tendency to the increase of the cotton boll weevil..

4. The need to create a GIS database on harmful agro-ecological factors in plant protection is justified.

5. Remote sensing methods were used to determine the distribution areas of the Asian locust.

6. Using small-scale weather stations, the number of pest eggs in the field is analyzed depending on the relative humidity of the air.

Chapter IV. GIS-BASED ECOLOGICAL MONITORING OF AGRICULTURAL CROPS DISEASES

4.1-§. Forecasting the development of cytosporosis disease in apple orchards.

Cytosporosis disease in the olmazors established in 2005 in the region began to be clearly felt since 2015, especially in the olmazors of the Renet Simerenko variety. Horticulture farmers suffer a lot from this disease (see Figure 4.33. A).

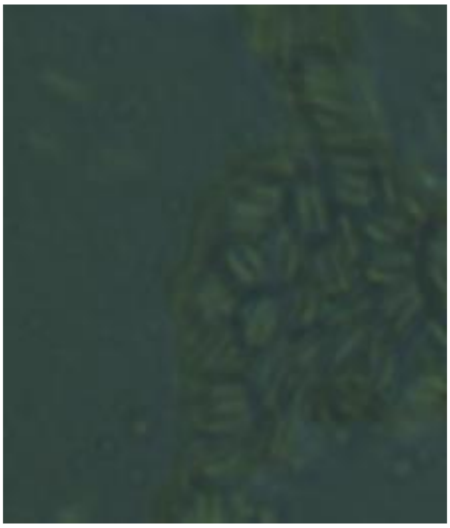
The disease causes the death of the bark on the branches and skeletal branches of fruit crops with seeds and grains. Initially, the symptoms of the disease resemble black cancer. However, later the bark turns into charcoal and does not become stained. Symptoms of the disease appeared on apple branches in the form of reddish-brown, soft spots of various sizes (see Fig. 4.33.B). As the disease progressed, these spots spread to healthy tissues and covered the whole branch. In particular, the spongy covering of the spots caused the upper part of the branch to dry out quickly. If there are favorable conditions for the development of the disease, after ten days the size of the spots exceeds 10 x 15 cm, and after two months it leads to the drying of the main branch. Drops appeared on the surface of newly formed spots, which then dried. The part connected to the surrounding healthy tissue remained wet. In some cases, it was observed that a number of spots that were formed joined together and formed a spot in the form of a single band. The damaged tissue hardened over time, and various cracks formed on its surface. As a result, the healthy tissue was separated from the damaged tissue by a crack. Dead bark turns reddish or brown and separates from the wood. Later, due to the formation of pycnidia under the dead tissue bark, many bumps appeared. This caused the surface of the affected branches to become rough.

A

B

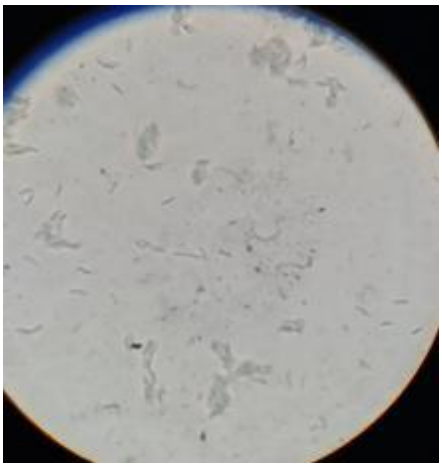
4.33-rasm. The degree of damage to trees by cytosporosis disease.

Cytosporosis disease also affected apple branches, symptoms of the disease were observed on the stem and main branch. Cytosporosis fungus in apples formed 0.9 - 1.4 mm pycnidia on the bark of infected branches with a blunt cone shape. Pycnidia are multi-chambered and have one slit. They were visible from the outside after the bark was cracked. Conidial bands are colorless, less branched, simple 13.5-28.7 x 2-3 µm in size. Mature conidia were observed to flow out of the pycnidia in the form of ribbons, held together by a mucilaginous fluid (see Figure 4.34 A). Conidia are colorless (see Fig. 4.34. C), first shiny-yellow, then brown, and finally dark, during the discharge from the pycnidia, sucker-shaped, 4.7-7.3 x 1-2 µm. has size. This fungus was observed to grow well on water agar and whey agar, where the colonies turned a gray color (see Fig. 4.34. D). Mehrabi, M., Mohammadi Goltapeh, E. and Fotouhifar, K.B., obtained from the morphological structure of the fungus. It was studied in comparison with the data of 2011. As a result, this disease was identified as Citospora sp. According to Fomenko's method, the tree trunk was burnt with an alcohol lamp and cut in a T shape, and the cut place was infected with a pure culture of the fungus. When the trees were infected with the disease, symptoms of the disease began to be felt in some trees after 24 days and others after 2 months. The low prevalence of cytosporosis in Khorezm region causes problems for farm managers in identifying this type of disease.



A

B



S

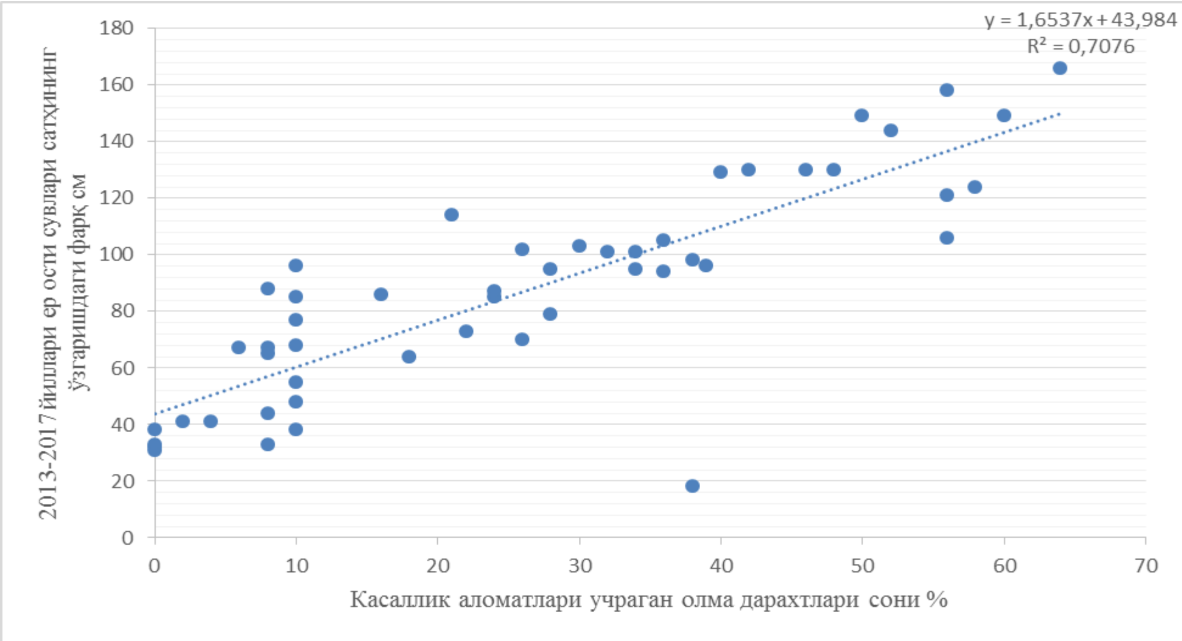
D

4.34- picture. Cytospora sp. morphological appearance of the fungus.

The distribution of cytosporosis disease in the villages of Khorezm region was studied for 5 years. According to the results of the received data, the susceptibility of apple trees to disease increases over the years. We conducted experiments in gardens established in 2005. After 10 years, Renet Simerenko, an apple variety common in Khorezm region, has an increased susceptibility to the disease. According to the obtained results, until 2017, the maximum rate of damage in the fields was 48.3% on average. Apple orchards were first damaged in Urganch and Khiva districts. By 2017, it can be seen that Khiva district was affected by 10.0% more than Khanka district and 10.1% more than Urganch district. Khiva district is close to the Ungizorti sandy desert, and there are very few large irrigation networks. Khanka district is less affected by this disease compared to the studied districts. Compared with irrigation networks, Amudarya and Polvan, Shavot, and Kulovot canals flow through the Khanka district.

In terms of soil mechanical composition, soils with light mechanical composition are widespread in Khiva district. Medium loamy soils are more common in Khanka district compared to Khiva district. Based on the obtained data, it can be concluded that the development of cytosporosis disease in gardens can vary in large ranges depending on environmental factors at the scale of districts (see Appendix 11).

Cytosporosis disease is one of the most dangerous diseases for apple trees, which damages the body part of the trees. This causes the mass of its fruits to decrease and the branches and the whole body of the trees to dry up. Due to the lack of fungicides to treat this disease, preventive measures have been developed to identify and prevent their outbreaks. In the fight against this disease, it is important to determine the areas and periods of their spread. It is very convenient to do these things on the basis of GIS technologies. To do this, it is necessary to identify a different dominant factor for the spread of cytosporosis disease. Scientists of the world have proven that cytosporosis disease is more common in trees with reduced immunity. Moisture is one of the factors that decrease the immunity of trees in the conditions of Khorezm region. Because in the conditions of the region, the relative humidity of the atmosphere is very low, and it is found that in the summer months it is as low as 18-20%. The presence of groundwater in the region can provide the trees with an excessive amount of moisture. Another characteristic of the region is that the level of underground water varies over a wide range. For this reason, 2150 wells have been installed in the region to constantly study the level and salinity of underground water, one for every 100 hectares of land. On the basis of the data obtained from these wells, it is possible to predict the probability of damage to apple orchards of the Renet Simerenko variety by cytosporosis. We conducted research in 49 apple orchards of Khorezm region from 2013 to 2017. In this case, the coordinates of the field were recorded using a GPS navigator and the difference in the level of underground water was analyzed. Electronic digital maps were developed based on the coordinates obtained through the navigator. The selected fields corresponded to Khanka, Urganch, Khiva, Koshkopir districts. Information on the level of underground water was obtained through measuring wells near the gardens. It shows the change of groundwater levels in apple orchards from 2013 to 2017.



4.35- picture. The dependence of changes in the level of underground water in apple orchards on the development of cytosporosis disease (2013-2017).

The difference between the indicators of the deepest and the shallowest groundwater levels was calculated. These differences show how the groundwater has changed. In this case, the trees are adapted to change the environment.

In this case, we can know that the soil surface or the roots of apple trees have remained in very wet or, conversely, dry soils in certain years. Irrigation system depending on underground water has not been developed. However, the level of underground water varies depending on the irrigation water rate allocated to the region or the type of crops planted next to it. Rice may be planted as a side crop. If the groundwater level is high in the gardens this year, it may be deep in the year of cotton planting. Constantly rising groundwater levels can lead to soil salinization. In such cases, the immunity of trees will decrease further. Currently, constant monitoring of the underground water level in the orchards leads to the extension of the life of apple trees. We analyzed the level of groundwater in relation to the development of cytosporosis (Fig. 4.36). It was found that there is a 70% correlation with the increase of the disease in the areas where the underground water has changed dramatically. With the decrease in the immunity of apple trees of the Renet Simerenko variety, there are favorable conditions for the fungi of the genus Cytospora, which are facultative parasites living in the soil, to live as parasites in their bodies. This can lead to a decrease in the productivity of apple trees and even to complete withering. Therefore, it is necessary to prevent the development of the disease. For this, it is necessary to establish a well-developed monitoring system. Entering the monitoring results into the GIS database. It will be possible to have more information on the occurrence and development of the disease and to conduct a comparative analysis. If specialists have more information about the bioecology of the disease and geo-information, it will be possible to prevent the development of the disease.

Conclusions on Chapter IV

1. The distribution of cytosporosis disease has been shown in the conditions of Khorezm region. The morphological characteristics of the disease-spreading fungus were studied on the basis of laboratory experiments.
2. A 60% higher correlation with sudden changes in groundwater was found in predicting cytosporosis-prone areas..
3. The necessity of monitoring results of environmental factors in predicting the development of diseases in apple trees has been shown, and a GIS database has been created for the development of methods for remote detection of areas prone to cytosporosis.
4. Digital data is used in the study of diseases. Using GPS navigators, digital maps have been developed, marking the affected areas. The possibility of underground water monitoring in predicting the cytosporosis disease of trees in the conditions of Khorezm region is substantiated.

Chapter V. EFFECTIVENESS OF PEST AND DISEASE CONTROL BASED ON GIS TECHNOLOGIES

5.1. Effectiveness of control against cytosporosis diseases in apple trees.

A 3% solution of copper sulfate from fungicides against cytosporosis of Renet Simerenko apple variety was applied to apples of all variants on March 5 in early spring during budding. During the growing season, 1 kg of fundazol powder, 200 g of Topsin concentrate, 200 g of impact concentrate, and 10 kg of copper burgundy liquid were used per hectare. See table 5.1, it can be seen that in the control option, the disease prevalence is 20% and the disease development is 6.9. In the case where Fundazol fungicide was used, the spread of the disease was 14%, the development of the disease was 6.1, and the efficiency was 56.6%. In the case of copper burgundy liquid suspension of 10 kilograms per hectare during the growing season, the spread of the disease was 12% and the development was 4.1. Cytosporosis is one of the most dangerous diseases for trees, and the absence of fungicides to treat it shows that prevention of its development is an urgent issue. We applied it to the farm fields of "Rozzoq" in Khanka district, "Davron" in Khiva district, and "Bakhrom Makhfuza" in Gurlan district. Efficiency was 40.5%. In the variant where the suspension concentrate of the impact fungicide was used, the spread of the disease was 16%, and the level of the spread of the disease was 3.8. Efficiency was 46.9%. In the variant used from the suspension concentrate of topsin fungicide, the spread of the disease was 18%, and the prevalence rate of the disease was 3.3. Efficiency was 52.1%. The effectiveness of the variant using Fundazol fungicide is 16.1% compared to the variant using Bordeaux liquid. It was observed that it was 9.7% higher compared to the variant using Impact fungicide, and 4.5% higher than the variant using Topsin M fungicide (see Table 5.14). No fungicide with high efficacy was found in the literature against cytoprosis disease.

5.14 – table

Renet Simerenko, Khorezm region, effectiveness of fungicides used against cytosporosis in cultivars

Variant	Standard	Disease spread	Disease development	Efficiency
Control		2.0	6.9	
Fundazol Cook. Benomyl 500g/kg	0.5	18	3.9	4.3
	1	1.4	3.1	56.6
	1.5	1.4	3.2	54.0
Impact sus. conc flutriafol 250 g/l	0.1	18	4.2	32.2
	0.2	16	3.8	45.0
	0.5	17	4.0	42.0
Topsin M. Thiophonate-methyl 700g/kg	0.1	19	5.2	24.6
	0.3	18	3.3	52.1
	0.5	17	3.4	50.7
Bordeaux liquid	1%	12	4.1	40.5

In order to protect apple trees from cytosporosis disease, it is important to identify areas with a high probability of pest development and to apply countermeasures. In the conditions of Khorezm region, favorable conditions are created for the development of cytosporosis disease in apple trees as a result of sudden changes in the level of underground water in large ranges.

In the research work, the areas with sharp changes in the groundwater level were identified, and treatment of those gardens with 3% copper sulfate and fundazol fungicide during the rest period after flowering is considered to be an effective method in the fight against cytosporosis (see Table 5.15).

Treatment of adult orchards, where the level of underground water has not changed in large ranges, only during the rest period with a preparation of 3% of copper sulfate prevents the development of the disease. The level of underground water in the farm field "Rozzoq" of Khanka district has not changed in large ranges, but in the farm "Bahrom Makhfuza" of Gurlan district, the level of underground water has changed in large ranges. For this reason, apple trees were more affected by the disease in these fields compared to experimental fields in Khanka district.

5.15- table

Use of pesticides in the fight against apple cytosporosis by using GIS technologies

№	Used fungicides	Perepar at spending norm	2015 yil		2016 yil		2017 yil	
			spreading	development	spreading	development	spreading	development
Rozzoq farm, Khanka district (damage rate %)								
1	3%+bodos liquid during the rest period of copper oxide (template)						3,3	0,06
2	Copper sulfate 3% +Fundazol	0.5 kg/ga	-	-	-	-	-	-
3	Copper sulfate 3% +Fundazol	1.0 kg/ga	-	-	-	-	-	-
4	Copper sulfate 3% +Fundazol	1.5 kg/ga						
5	Control option				21.8	5.0	83.3	6.8
Bakhrom Makhfuza farm, Gurlan district								
6	3%+bodos liquid (template) during the rest period of copper oxide		-	-	25,5	0,36	30	0,73
7	Copper sulfate + Fundazol	0.5 kg/ga	-	-	10	0,2	20	0,5
8	Copper sulfate + Fundazol	1.0 kg/ga	-	-	-	-	-	-
9	Copper sulfate + Fundazol	1.5 kg/ga	-	-	-	-	-	-
10	Control option		40	3,9	50,9	21,6	75,5	26,6

Rice is planted in Gurlan district. This has a strong impact on the level of underground water. In 2017, the disease began to be observed in experimental fields of Khanka district.

Because as a result of a sudden change in groundwater, a change in the air and water regime in the root system of plants makes it possible for cytosporosis to enter the trunk of trees (see Table 5.16). As a result, apple trees begin to be affected by this disease. In order to reduce the damage, it is necessary to monitor the groundwater daily and treat it with the above-mentioned drugs. The annual average indicator of groundwater salinity in the experimental fields of Khanka district has an average salinity of 0.6-1.2%, in the experimental fields of Gurlan district it has an average salinity of 0.8-14%.

5.16- table

Changes in the level of underground water in experimental areas over the years

The area where the experiment was conducted	Groundwater level m.			
	2014 year	2015 year	2016 year	2017 year
Rozzoq farm, Khanka district	2.20	2.0	2.35	1,40
Bakhrom Makhfuza farm, Gurlan district	2.45	1.50	2.80	2.75

As a result of malfunctioning of irrigation irrigation systems due to close proximity of groundwater in the fields, their level may change dramatically as a result of non-observance of the procedure for placing crops. For example, in the years of water scarcity, underground water falls to very deep layers, and in years of water abundance, it rises to the surface layers. It has been proven that the rise of underground water to the surface layers leads to soil salinization in reclamation. Soil salinity can decrease the immunity of trees. This process also creates conditions for damage to trees.

5.17- table

Renet Simereko Economic efficiency of protection of apple variety against cytosporosis disease

№	Indicator	Control	Fundazol	Bordeaux liquid

1.	Productivity ts/ha	90.2	110.2	108.7
2.	preserved yield, ts/ha		22.6	15
3.	A liter of the drug per hectare		1	150
4.	The total price of the drug per hectare is soum		220000	70000
5.	Soums for the service and tractor for protecting one hectare		41400	41400
6.	Total expenditure on protection, ha/soum		261400	111400
7.	cost of collecting and transporting additional crops, ha/soum		30000	20000
8.	Total cost of plant protection and additional crop harvesting, ha/soum		291400	131400
9.	Total cost of crop cultivation, ha/soum	14010000	14010000	14010000
10.	Total: spending, soum	14010000	14301400	14141400
11.	The total price of the crop obtained per hectare	18040000	22040000	21740000
12.	Value of additional harvest, soums/ha	0	4520000	3000000
13.	Conditional net profit sum, soums	4030000	7738600	7598600
14.	Economic efficiency compared to control, ha/sum		3708600	3568600
15.	Compared to the model, ha/soum		140000	
16.	justification of spent 1 soum, times	1.28	1.57	1.55
17.	The usefulness of the protection method (profitability),%	128.7651677	157.3162027	155.1748751

The efficacy of fungicides against cytosporosis of Renet Simerenko varieties of apple was determined. The economic efficiency of fundazol, impact, Topsin-M, 3% solution of Bordeaux liquid, fungicides was studied. (see table 5.20) In this case, fundazol fungicide was studied and found to have high efficiency compared to other fungicides (Appendix 13).

In the case of applying 1 kg of Fundazol per hectare, economic efficiency of 3,708,600 soums compared to the control option and 140,000 soums compared to the model option was achieved. It was observed that this indicator is higher than other impact, topsin-M used variants.

5.2. Economic efficiency of managing the amount of cotton tunnel using GIS technologies

In Uzbekistan, the fight against the cotton bollworm is carried out mainly by biological methods. Determining the place and time of spread of the pest is considered one of the most important factors in the biological control method. We identified foci of spread of the cotton worm in the fields of the farm "Davron" of Khiva district under the control of the bioservice biolaboratory of Khanka "Sarapayon". In this case, it was observed that the lands of the farm "Davron" of Khiva district entered areas with a low level of comfort for the development of cotton cultivation. Distribution of trichogram from 0.5 g to such areas was also highly effective. Cotton has been grown on the lands owned by the Sarapayon bioservice of Khanka district, and the biomass coefficient above 0.6 is considered favorable and very favorable areas for the development of cotton groves (Appendix 10). 5x5 m to 400 places from 1 g to such areas. a trichogram was used in the scheme. In traditional methods, the distribution of male cotton moth butterflies is estimated based on their landing on pheromone traps. This method is labor intensive and it is difficult to get accurate information about the fields where the female butterflies can fly. In addition, the areas where the cotton moth can lay eggs are monitored in traps filled with sugar solution. Improvement of GIS technologies increases the economic efficiency of early detection of the appearance of many pests and diseases of agricultural crops and the implementation of control measures. Because this method predicts areas with a high probability of laying eggs. Bioproduct is initially distributed to areas predicted to have a high probability of damage (see Tables 5.17-5.18). In this case, the bioproduct standard may also be different. For example: 1 gr. can be distributed 3 times. In this case, the development of cotton wool and the appearance of spreading planes will be prevented. Also, specialists will have the opportunity to get acquainted with permanent archival information about the distribution areas of insects. GIS technologies allow multi-year distribution maps of insects to be produced when needed with little effort. In the future, conclusions will be made about the foci of the spread of insects. With the help of the database created for use in GIS technologies, it is possible to take measures against the cotton bollworm not after it has started to damage the field, but to determine its entry into the field at that moment.

Fewer bioproducts were distributed to areas with a low probability of the spread of cotton bollworm. On the basis of GIS technologies, 1 g of 400 places three times every three days in the fields with a high probability of egg-laying of the cotton nightingale was saved. It is required to carry out field inspections to identify the areas with a high probability of the spread of cotton bollworm in the fields. A lot of money and skilled workers are needed for field inspector work.

5.18- table

Effectiveness of trichogram application against cotton bollworm (Heliothis armigera Hb) in cotton fields under Sarapayon bioservice of Khanka district

Options	Until the trichogram is released	Total Piece	Damaged piece 5 days	Total	Damaged piece 10 days	Total piece	Damaged 15 days	Biological efficiency % After 5 days	Biological efficiency % After 10 days
Trichogram 0.5 g for 100 places	1.3	3.6	1.2	3.2	0.9	1.3	0.7	33.3	8
Trichogram 1 gr in 100 places	2.8	4.6	2.8	3.1	0.3	1	0	60.9	6
Trichogram 1 gr for 400 places	3.5	4.5	3.3	2.9	0.5	0.3	0	73.3	7.2
Control	3.8	5.2	-	3.4	-	1.6	0	0	

5.19- table

Effectiveness of trichogram application against cotton bollworm (Heliothis armigera Hb) in the fields of Davron farm, Khiva district

Options	Until the trichogram is released	Total Piece	Damaged piece 3 days	Total	Damaged grain 6 days	Total pcs	Damaged 9 days	Biological efficiency % After 3 days	Biological efficiency % after 10 days
Trichogram 0.5 g per 100 places	0.6	0.5	0.2	0,2	0.2	0	0	0	0
Trichogram 1 gr in 100 places	0.8	0.6	0.4	0,2	0,2	0		6.6	0
Trichogram 1 gr for 400 places	1.1	0.9	0.6	0	0	0	0	66.6	0
Control	1.1	1.2	0	0.4	0,4	0.0	0	0	0

This leads to an increase in the price of agricultural products. In order to prevent this, it is necessary to improve the prediction of the areas with a high probability of developing cotton rust. First, it is necessary to spread the bioproduct to the areas where there is a high probability of the spread of the cotton bollworm.

Protection of plants from harmful organisms is one of the urgent issues. The fact that pest organisms and environmental protection are contradictory concepts requires a high level of knowledge from experts. It is practically impossible to use chemical protection means by representatives of the field who do not have deep knowledge. Therefore, it is necessary to identify breeding sites of harmful organisms in agricultural crops in advance and develop measures to combat them without harming plants. The implementation of these works requires the involvement of representatives of many fields, such as information technology, ecology, soil science, land reclamation. To date, perfect methods of combating harmful organisms using information technologies have not been developed. Therefore, in this work, the most urgent issues for the republic's agriculture, including the development of the theoretical basis for increasing the effectiveness of the biological control method against the cotton bollworm, and their application in agricultural production processed.

In cotton farming, cotton bollworm is mainly combated by biological methods. To increase the effectiveness of biological control, it is important to determine the fields where the cotton blight appears and the time of its appearance. The prospects of the field of protection of plants from pests and diseases also depend on economic indicators. Nevertheless, in the development of plant protection, quality indicators and their characteristics are taken into account, in addition to economic indicators.

5.20- table.

Economic efficiency of biological protection of cotton from cotton bollworm (Heliothis armigera Hb) using GIS technologies

№	Indicator	Control	Traditional method	GIS is the method used
1	Productivity ts/ha	27.5	29.05	30.88
2	The saved yield, ts/ha		1.55	3.38
3	Trichogram gr per one hectare.		9	4.5
4	The total price of the drug per hectare is soum		54000	27000
5	Service and tractor fee for the protection of one hectare is soums		54000	27000
6	Total expenditure on protection, ha/soum		54000	27000
7	The cost of collecting and transporting additional crops, ha/soum		155000	338000
8	Total cost of plant protection and additional crop harvesting, ha/soum		209000	365000
9	Total cost of crop cultivation, ha/soum	5277775.7	5277775.7	5277775.7
10	Total: spending, soum	5277775.7	5486775.7	5642775.7
11	The total price of the crop obtained per hectare	5500000	5810000	6176000
12	Value of additional harvest, soums/ha	0	310000	676000
13	Conditional net profit sum, soums	222224.3	323224.3	533224.3
14	Economic efficiency compared to control, ha/sum		101000	311000
15	Compared to the model, ha/soum			210000
16	Receipt of spent 1 soum, once	1.04210567	1.10084254	1.170189934
17	The usefulness of the protection method (profitability),%	104.210567	110.084254	117.0189934

The combination of these indicators leads to the economic development of the field of plant protection.

In order to use any technologies in the field of plant protection, it is necessary to take into account its economic aspects. In this case, the crop lost by the pest organism should also be taken into account. (See Table 5.19).

When GIS technologies are used against the cotton bollworm, damage to the farm fields by the cotton bollworm can be prevented. It is possible to achieve higher results with less effort. In order for the biolaboratory staff to identify the foci of pests with the help of GIS technologies, to lay eggs of cotton wool in areas prone to damage, apply 1 gram of cotton wool every 3 days to 400 places of very convenient and convenient fields. 0.5 gr to areas with low and very low level of comfort for laying eggs. 3 times application made it possible to increase the effectiveness of the fight against the cotton bollworm. More than 210,000 soums of economic efficiency was achieved from each hectare of land compared to the traditional method.

CONCLUSION

The following conclusions were presented as a result of the doctoral dissertation research on the topic "Fundamentals of using GIS technologies in the pest and disease control system":

1. Based on remote sensing methods, the area of development foci of Asian locust (Locusta migrotoria L.) was determined in the Amudarya delta.
2. In the Khorezm region, poplars planted in the desert zone have been identified and developed electronic maps of the distribution centers of poplar beetle (Monosteira discoidalis Jak), elm leaf beetle (Galerucella luteola Müll), urban mustache beetle (Aeolesthes sarta Solsk) .
3. Biomass NDVI index and atmospheric air humidity in cotton fields Collecting hygrometric data in each field using new methods to identify fields prone to the emergence of cotton weevil (Heliothis armigera Hb) and their comparative analysis methods have been developed.
4. The correlation between the biomass NDVI index in the cotton field and the prevalence of cotton bollworm (Heliothis armigera Hb) eggs was 30.5%, and between complex agroecological factors and cotton bollworm eggs in the field. correlation was shown to be 64.5%.
5. In the conditions of Khorezm region, it was found that the assessment of agroecological indicators based on the GIS database is an effective way to classify agroecological factors according to their susceptibility to damage by cotton boll weevil (Heliothis armigera Hb).
6. Since 2013-2014, in the conditions of Khorezm region, Renet Simerenko variety has been proven to be affected by the dangerous disease cytosporosis, and this disease is caused by Cytospora sp. it was found to cause.
7. It was shown that the occurrence of cytosporosis disease in the Renet Simerenko variety of apple in the conditions of Khorezm region is 70.76% correlated with sudden and large changes in groundwater.

8. Fundazol, impact, topsin preparations, 3% solution of bordeaux liquid are applied to damaged areas during the growth period in early spring, their efficiency is 56.6%, 45.0%, 52.1%, 40.0%, respectively. was recorded.
9. It was found that the first application of trichogram to the areas where the development of the cotton weevil (Heliothis armigera Hb) is predicted to be highly effective.
10. Trichogram savings were achieved by applying 0.5 g to cotton fields with low susceptibility to damage and 1 g to cotton fields with high susceptibility to damage in a 5x5 m scheme.
11. In Khorezm region, it is recommended to introduce environmental monitoring of pests and diseases of agricultural crops based on GIS technologies.
12. It is recommended to identify the areas prone to the reproduction of cotton boll weevil (Heliothis armigera Hb) eggs in the cotton fields and to implement rapid control measures in the areas with high initial susceptibility.
13. It is recommended to carry out environmental monitoring of the spread of pests and diseases through GIS technologies, forming long-term archival data based on digital electronic maps.

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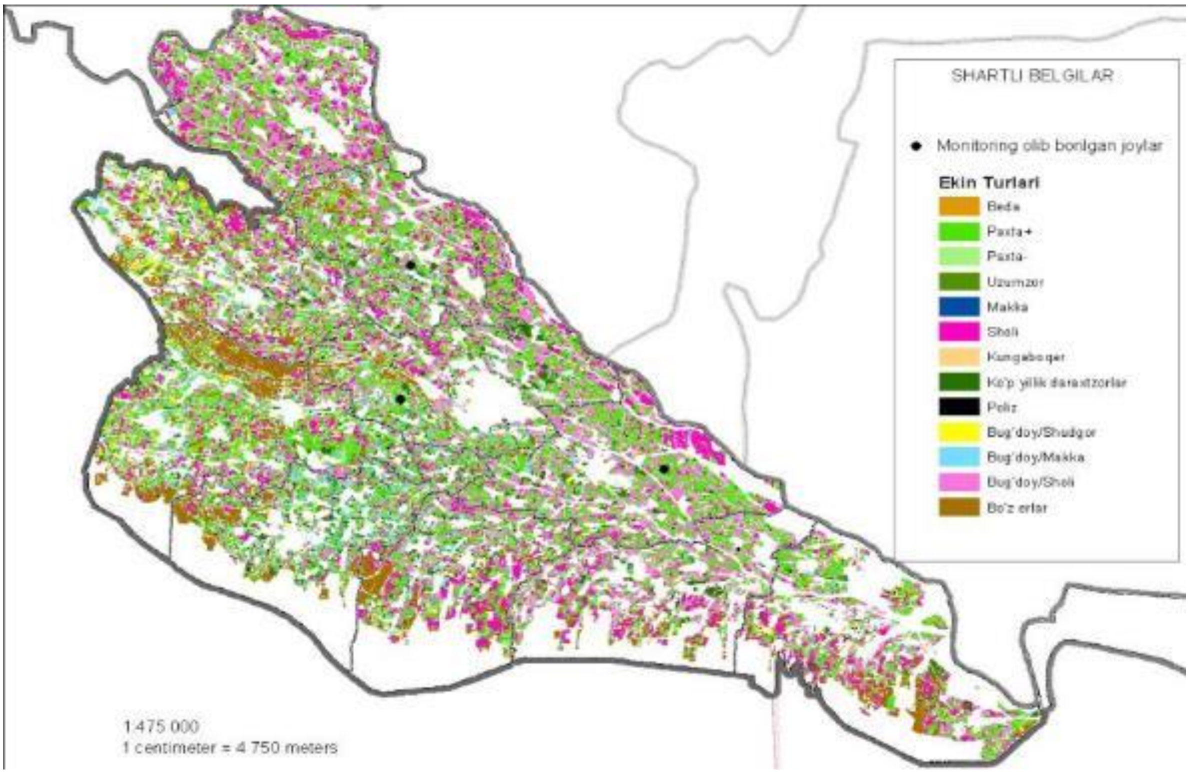
LIST OF TERMS AND SYMBOLS

ц.	centner
T	Ton
Ga	Hectar
^{0}S	Celcius Temperature
T	Temperature
FAO	The International Food Organization of the United Nations (Food and agroculture Organization under the UN –Unted Nations)
G	Gramm
m/sek	Meter/second
fungiцid	A pesticide used against fungal diseases
GPS	Global Positioning Sistem
GIS	Geographic Information System
Landsat	Name of Satellite
NDVI	Normalized Difference Vegetation Index
R-studio	Program for mathematical analysis of geographic data
Modis	Name of Satellite
ArcGIS	a computer program developed for the analysis of geographic data
Sef Unesco	Science Development Center under UNESCO
UN	United Nations Organization

APPLICATIONS

1- app

Digital map of the location of crops on irrigated lands of Khorezm region based on Landsat satellite image.

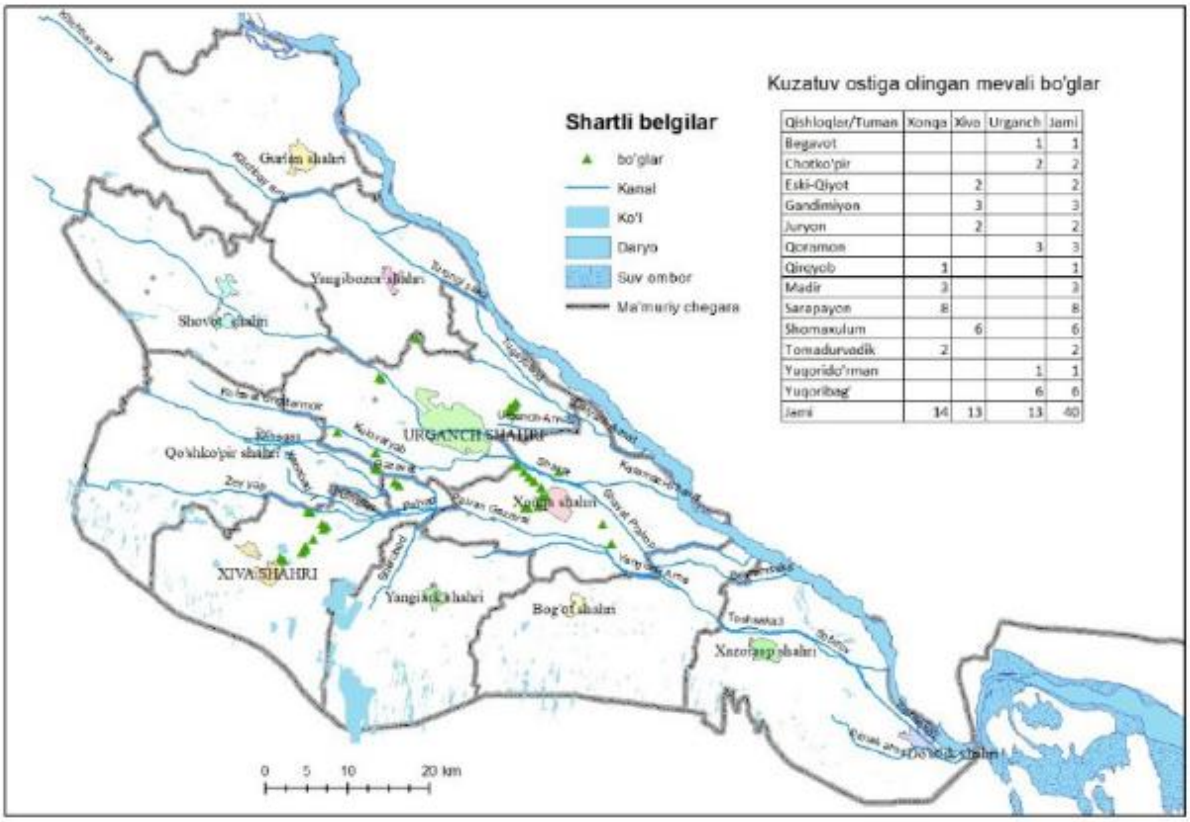


2- app

The mini-weather station installed in the field records data on a flash drive.

3- app

The coordinates of the research areas were determined using GPS and mapped (apple orchards).

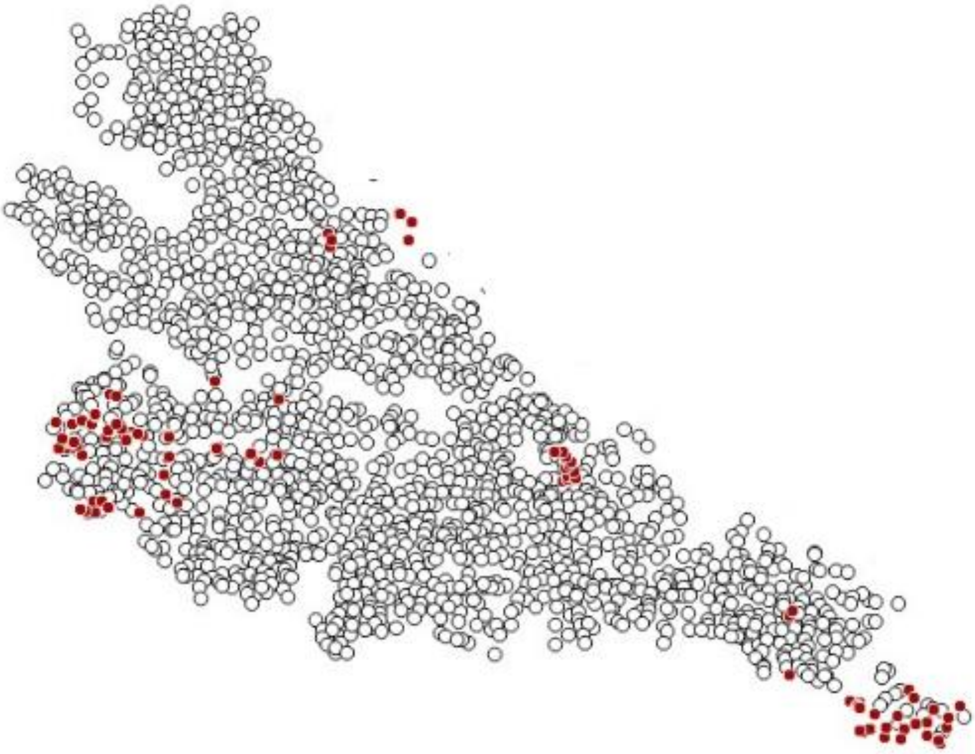


Qishloqlar/Tuman	Xonqa	Xiva	Urganch	Jami
Begavot			1	1
Chotko'pir			2	2
Eski-Qiyot		2		2
Gandimiyon		3		3
Juryon		2		2
Qoramon			3	3
Qiryob	1			1
Madir	3			3
Sarapayon	8			8
Shomaxulum		6		6
Tomadurvadik	2			2
Yuqorido'rman			1	1
Yuqoribag'			6	6
Jami	14	13	13	40

4- app

The process of studying the morphological characteristics of the fungus that causes cytosporosis

Location of groundwater monitoring wells in the conditions of Khorezm region (in red, areas where the earthworm was studied).



6- app

The Ministry of Agriculture and Water Resources, the Center for Plant Protection and Agrochemistry, and the Organization of the Locust Control Service have drawn up a document on the level of actual use.

АКТ

Мы, нижеподписавшиеся, составили настоящий акт о нижеследующем:

С целью оценки ситуации по заселенности стадными саранчовыми в Республике Каракалпакстан, нами проведено обследование угодий в дельте реки Амударьи на предмет выявления кубышек и личинок азиатской саранчи *Locusta migratoria migratoria* L., 1758 и итальянского пруса *Calliptamus italicus* (L., 1758).

Период обследования: со 2 по 9 мая 2013 года.

Места проведения обследования: Муйнакский район: участки Порлатау, Шеге, Аллиа-Аул, Казакдарья; Кегейлинский район: участки Аспантай, Бешершиэль; Чимбайский район: участок Шахаман; Кунградский район: участок Кунград; Тахтакупырский и Караузякский районы: участок Тахтакупыр.

Общая обследованная площадь: 351.200 га.

В результате проведения обследования выявлено следующее:

1. Залежи кубышек азиатской саранчи обнаружены на участках Шеге, Порлатау и Казакдарья. Общая площадь залежей составляет 111.000 га.

2. Плотность кубышек на отдельных залежах очень высокая. Максимальная выявленная плотность составила свыше 110 кубышек на 1 кв. м. в урочище Карамыш. Перезимовка яиц произошла успешно, гибели яиц от паразитов и болезней не отмечено.

3. Единичное отрождение личинок азиатской саранчи отмечено на участке Порлатау, урочище Карамыш. При установлении сухой и жаркой погоды следует ожидать массовое отрождение личинок во второй декаде мая.

4. Оценка ситуации резко осложнена тем, что многие залежи кубышек участков Порлатау и Казакдарья находятся в труднодоступных местах, которые невозможно обследовать наземным транспортом. Часть зараженной кубышками территории остается до сих пор под водой. По предварительной оценке эта площадь составляет 38.000 га. Отрождение с этих участков произойдет позже, по мере обсыхания. Поэтому мониторинг этой площади следует продолжать в течение июня.

5. В 2013 г. в Приаралье наблюдается сильная засуха. Затопленные водой участки быстро обсыхают, что создает благоприятные условия для массового отрождения и быстрого развития стадной фазы азиатской саранчи. Особенно опасная ситуация создается на участках Порлатау, Шеге и Казакдарья.

6. Площадь заселения кубышками итальянского пруса составила 7.000 га в Муйнакском, Кунградском и Кегейлинском районах. В отдельных участках плотность кубышек составляет до 10 штук на 1 кв. м. Началось единичное отрождение; массовое отрождение ожидается с середины мая.

На основе данного обследования рекомендуется следующее:

1. Организовать два полевых участка, Карамыш-1 и Карамыш-2. Оборудовать взлетно-посадочную полосу для самолета Ан-2 и мотодельтапланов.

2. Укомплектовать штат полевых работников, обеспечить их регулярным трехразовым горячим питанием, молочными продуктами и питьевой водой, для чего предоставить водовозки в количестве 4 (четыре) и емкости для питьевой воды в количестве 4 (четыре).

3. Оснастить полевые участки 15-местными палатками в количестве 9 (девять) штук и душевыми кабинами.

4. Предоставить водовозный автотранспорт в количестве 4 (четырех) единиц, мотоводопомпы в количестве 5 (пять) единиц и бензиновые электрогенераторы в количестве 5 (пять) штук.

5. Обеспечить полевых работников постельными принадлежностями в количестве 100 (сто) комплектов.

6. Обеспечить полевые участки спутниковыми телефонами в количестве 5 (пять) штук, аппаратами GPS в количестве 5 (пять) штук, биноклями в количестве 10 (десять) штук.

7. Обеспечить полевые участки моторными лодками с мотором «Вихрь» в количестве 4 (четыре) штуки.

8. Оснастить полевые участки ручными опрыскивателями ОРПД-12 в количестве 50 (пятьдесят) штук, а также автомобильными опрыскивателями УМО типа AU-8115 в количестве 4 (четыре) штуки.

9. Обеспечить службу отечественными инсектицидными препаратами на основе действующего вещества лямбдацигалотрин (Атилла) на площадь 30.000 га.

10. Обеспечить службу автомашинами повышенной проходимости для обследования типа «Тойота Ландкрузер» в количестве 1 (одна) штука, УАЗ «Хантер» в количестве 5 (пять) штук, а также мотоциклами «Урал» в количестве 5 (пять) штук.

11. Обеспечить службу тракторными прицепами в количестве 6 (шесть) штук.

12. Привлечь специалистов Ургенчского Государственного Университета для проведения экспресс-оценки распространения тростников и воды в дельте Амударьи на основе дистанционного зондирования.

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7- app

Coordinates of the distribution centers of the urban mustache in the conditions of the Khorezm region

code	Y	x	TreeTypes
0	41,677650	60,423802	Apple orchard
1	41,684023	60,425845	Apple orchard
2	41,471189	60,750269	Jiida
3	41,469494	60,793131	Poplar grove
4	41,554407	60,472725	Poplar grove
5	41,553538	60,471180	Apple orchard
6	41,553104	60,470536	Apple orchard
7	41,554118	60,471593	Poplar grove
8	41,467858	60,792970	Pine
9	41,468348	60,756183	Pine
10	41,644902	60,680698	Pine
11	41,650978	60,672412	Pine
12	41,658386	60,644070	Pine
13	41,665302	60,624458	Pine
14	41,667327	60,667623	Pine
15	41,414160	60,247528	Pine
16	41,408358	60,218814	Pine
17	41,401509	60,235880	Pine
18	41,687225	60,424917	O'rik
19	41,490501	60,498779	Poplar grove
20	41,461160	60,466333	Poplar grove
21	41,415279	60,413301	Poplar grove
22	41,524461	60,695959	Poplar grove
23	41,514657	60,713135	Poplar grove
24	41,495198	60,744567	Poplar grove
25	41,609254	60,588874	Poplar grove
26	41,523470	60,697697	Apple orchard
27	41,517191	60,709805	Apple orchard
28	41,513046	60,716963	Apple orchard
29	41,509006	60,721937	Apple orchard
30	41,498496	60,738544	Apple orchard

31	41,505276	60,514908	Apple orchard
32	41,443254	60,814212	Jiida
33	41,461198	60,803302	Jiida
34	41,775781	60,504871	Jiida
35	41,373556	60,903699	Jiida
36	41,402195	60,243705	Jiida
37	41,651998	60,621593	Jiida
38	41,806583	60,432439	Jiida
39	41,512199	60,724609	Jiida
40	41,497479	60,770799	Jiida

8-app.

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0,64
R Square	0,027
Adjusted R Square	0,012
Standard Error	0,054
Observations	85

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	14	7,60	0,054	1,85	0,05
Residual	70	20,57	0,029		
Total	84	28,16			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
ndvi 10-may	0,16	0,067	0,024	0,81	-1,18	1,49	-1,18	1,49
ndvi 10-june	0,83	0,063	0.131	0,20	-0,43	2,09	-0,43	2,09
ndvi 27-june	-0,82	0,061	-1,35	0,18	-2,02	0,39	-2,02	0,39

ndvi 29-july	0,99	0,081	1,23	0,22	-0,62	2,60	-0,62	2,60
ndvi 30-aug	-1,82	0,136	-1,33	0,19	-4,54	0,91	-4,54	0,91
ndvi 15-sep	-0,11	0,123	-0,09	0,93	-2,57	2,34	-2,57	2,34
ndvi 1-oct	-0,74	0,100	-0,074	0,46	-2,72	1,25	-2,72	1,25
kanal	1,02	0,044	0.233	0,02	0,15	1,90	0,15	1,90
drenaj	-1,01	0,043	-0.234	0,02	-1,87	-0,15	-1,87	-0,15
yer osti suv sathi	0,39	0,037	0.104	0,30	-0,35	1,13	-0,35	1,13
yer osti suv sho'r	0,43	0,027	1,60	0,11	-0,11	0,97	-0,11	0,97
mexanik tarkib	0,00	0,01	-0,016	0,87	-0,01	0,01	-0,01	0,01
bonitet	0,01	0,04	0,027	0,79	-0,07	0,09	-0,07	0,09
rel'ef	0,01	0,01	0,084	0,40	-0,02	0,04	-0,02	0,04

The coordinates of the areas analyzed on the basis of GIS technology in the cotton fields are in digital form.

x	Y	Density of irrigation networks m/ha	Soil density m/ha	The depth of underground water m	Ground water salinity %	Soil mechanical composition and particles %	Credit score	Soil salinity according to electrical conductivity	ndvi
60,139524	41,507456	0,51	0,54	1,36	1,61	45,00	4,00	88,00	0,34
60,1409	41,506874	0,52	0,54	1,22	1,53	45,00	4,00	88,00	0,41
60,129036	41,507308	0,47	0,57	1,69	1,28	45,00	5,00	87,00	0,32
60,153128	41,500468	0,46	0,40	1,30	1,69	30,00	3,00	87,00	0,51
60,119006	41,507709	0,46	0,57	1,49	1,59	45,00	6,00	85,00	NA
60,12083	41,507868	0,47	0,57	1,53	1,52	45,00	6,00	86,00	0,34
60,135445	41,514538	0,49	0,58	1,43	1,74	60,00	7,00	88,00	0,34
60,136898	41,514166	0,50	0,58	1,43	1,74	60,00	7,00	88,00	0,34
60,138304	41,513873	0,50	0,60	1,41	1,82	60,00	7,00	88,00	0,34
60,146836	41,510944	0,52	0,59	1,29	1,72	45,00	4,00	90,00	0,38
60,140922	41,515088	0,48	0,61	1,40	2,00	45,00	5,00	89,00	0,36
60,126424	41,518929	0,42	0,58	1,41	1,79	45,00	6,00	88,00	0,48
60,153405	41,537102	0,44	0,68	1,31	1,96	45,00	3,00	90,00	0,35
60,167424	41,533476	0,45	0,72	1,36	2,01	30,00	0,00	88,00	0,36
60,117624	41,536636	0,32	0,40	1,32	2,08	45,00	6,00	86,00	0,36
60,221945	41,522875	0,47	0,86	1,36	2,19	60,00	7,00	90,00	0,52
60,191357	41,526011	0,40	0,79	1,36	2,21	45,00	4,00	90,00	0,34
60,211242	41,519973	0,46	0,94	1,35	2,26	60,00	7,00	89,00	0,15
60,208596	41,526628	0,45	0,92	1,34	2,39	60,00	7,00	91,00	0,44
60,215673	41,514981	0,46	0,91	1,38	2,19	60,00	7,00	91,00	0,38
60,274887	41,518151	0,63	0,92	1,74	2,05	45,00	2,00	92,00	0,71
60,274868	41,516786	0,63	0,92	1,79	2,03	45,00	2,00	91,00	NA
60,425868	41,493033	0,63	0,89	1,66	1,89	30,00	3,00	94,00	0,21
60,342593	41,499146	0,55	0,79	1,25	2,19	60,00	4,00	94,00	NA
60,387958	41,493642	0,66	0,82	1,39	2,14	10,00	0,00	94,00	0,59
60,389864	41,495153	0,66	0,82	1,45	2,18	30,00	6,00	92,00	0,42
60,339223	41,501772	0,55	0,81	1,31	2,16	60,00	4,00	93,00	0,21
60,340961	41,501923	0,59	0,80	1,29	2,21	60,00	4,00	92,00	0,40
60,282131	41,447168	0,39	0,76	1,09	1,72	30,00	6,00	90,00	0,33
60,267365	41,455582	0,34	0,67	1,22	2,28	45,00	3,00	89,00	0,60
60,268524	41,455345	0,34	0,67	1,21	2,24	45,00	6,00	89,00	0,39
60,26618	41,476054	0,44	0,50	1,18	2,28	30,00	3,00	93,00	0,45
60,229557	41,437153	0,40	0,77	1,38	2,63	30,00	3,00	90,00	0,22

60,165454	41,452203	0,52	0,57	1,67	2,10	30,00	3,00	87,00	0,46
60,176926	41,451756	0,55	0,63	1,56	2,37	20,00	2,00	90,00	0,32
60,166802	41,439742	0,34	0,57	1,46	1,86	20,00	3,00	88,00	0,33
60,15296	41,441007	0,30	0,54	1,33	1,75	20,00	2,00	89,00	NA
60,148289	41,443473	0,37	0,51	1,42	1,89	30,00	2,00	88,00	0,37
60,18538	41,444772	0,50	0,67	1,54	2,30	30,00	3,00	89,00	0,43
60,233949	41,519375	0,49	0,92	1,27	1,99	45,00	7,00	87,00	0,61
60,235684	41,518625	0,49	0,94	1,22	1,94	45,00	7,00	89,00	0,38
60,237704	41,518091	0,48	0,97	1,13	1,86	60,00	4,00	90,00	0,29
60,271987	41,493875	0,43	0,72	1,19	1,87	30,00	3,00	92,00	0,44
60,274529	41,49585	0,43	0,73	1,25	1,96	30,00	3,00	91,00	0,41
60,232167	41,519792	0,49	0,91	1,29	1,97	45,00	7,00	88,00	0,39
60,193499	41,562584	0,40	0,78	1,31	2,07	45,00	4,00	88,00	0,33
60,203067	41,561912	0,44	0,77	1,33	1,97	45,00	4,00	90,00	0,78
60,17257	41,543133	0,41	0,80	1,28	2,12	60,00	7,00	88,00	0,38
61,223071	41,198745	0,40	0,52	0,95	1,62	10,00	0,00	110,00	NA
61,220686	41,20038	0,41	0,50	0,96	1,61	20,00	0,00	110,00	0,24
61,221629	41,201162	0,42	0,50	0,96	1,62	20,00	0,00	111,00	0,24
61,223059	41,198745	0,40	0,52	0,95	1,62	10,00	0,00	110,00	NA
61,327076	41,19297	1,05	0,64	0,69	1,53	20,00	2,00	113,00	0,80
61,244865	41,192481	0,60	0,58	0,89	1,71	10,00	6,00	110,00	0,26
61,223577	41,175122	0,21	0,42	0,91	1,57	10,00	3,00	107,00	NA
61,316065	41,180542	0,93	0,69	0,89	1,56	20,00	5,00	113,00	0,80
61,300236	41,180076	0,85	0,78	0,86	1,50	20,00	6,00	112,00	0,63
61,315285	41,16645	0,56	0,52	1,16	1,41	20,00	6,00	112,00	0,56
61,364419	41,195623	0,86	0,27	0,81	1,51	20,00	4,00	115,00	0,42
61,334058	41,157139	0,37	0,37	1,24	1,37	10,00	4,00	114,00	NA
61,332413	41,160824	0,44	0,46	1,38	1,25	20,00	6,00	113,00	0,45
61,343527	41,173593	0,76	0,48	1,01	1,71	20,00	6,00	113,00	0,47
61,300251	41,206453	0,93	0,57	0,84	1,72	20,00	7,00	112,00	0,64
61,346048	41,185082	0,94	0,45	0,78	1,77	20,00	2,00	112,00	0,44
61,283375	41,174451	0,71	0,73	0,80	1,34	20,00	3,00	111,00	0,76
61,27833	41,164944	0,57	0,56	0,83	1,42	20,00	4,00	111,00	NA
61,227974	41,173482	0,26	0,44	0,90	1,57	10,00	3,00	109,00	NA
61,235815	41,177185	0,38	0,51	0,87	1,58	10,00	0,00	110,00	NA
61,221611	41,175917	0,24	0,43	0,91	1,57	10,00	0,00	109,00	NA
61,255854	41,166856	0,44	0,56	0,82	1,49	10,00	6,00	110,00	NA
61,259075	41,177817	0,56	0,68	0,80	1,44	20,00	4,00	109,00	0,81
61,127529	41,237773	0,55	0,56	0,96	1,31	30,00	4,00	105,00	0,61
61,137083	41,30392	0,85	0,65	0,90	1,55	45,00	4,00	108,00	0,36
61,127542	41,237789	0,55	0,56	0,96	1,31	30,00	4,00	105,00	0,61

60,612549	41,740773	0,53	0,29	1,30	1,51	30,00	3,00	96,00	0,71
60,627446	41,731551	0,69	0,27	1,21	1,46	30,00	4,00	97,00	0,69
60,509382	41,72299	0,67	0,79	2,12	1,16	45,00	3,00	96,00	0,84
60,82429	41,45247	1,04	1,13	1,56	1,37	45,00	4,00	105,00	0,88
60,83035	41,4532	1,04	1,09	1,28	1,72	45,00	4,00	103,00	0,83
60,83208	41,45763	0,93	1,07	1,26	1,91	45,00	4,00	103,00	0,85
60,843	41,45348	0,91	1,00	1,11	1,91	45,00	4,00	102,00	0,88
60,83372	41,4697	0,88	1,03	1,31	1,56	30,00	3,00	101,00	0,77
60,83092	41,47796	0,90	1,08	1,20	1,50	45,00	4,00	101,00	0,82
60,81434	41,484459	0,74	0,89	1,44	1,70	45,00	4,00	100,00	0,77
60,81387	41,48339	0,74	0,93	1,38	1,68	45,00	4,00	101,00	0,49

Biomass coefficient on the Landsat satellite

x	y	2017 eggs	10.may	10.june	27.june	29.july	30.august	15.september	1.october
60,340961	41,501923	0	0,10	0,26	0,37	0,62	0,62	0,57	0,42
60,267365	41,455582	0	0,11	0,25	0,43	0,81	0,70	0,44	0,26
60,509382	41,72299	0	0,48	0,40	0,30	0,09	0,13	0,11	0,09
60,282131	41,447168	0	0,09	0,15	0,39	0,68	0,52	0,41	0,33
60,612549	41,740773	0	0,10	0,38	0,50	0,82	0,68	0,61	0,37
60,627446	41,731551	0	0,37	0,44	0,42	0,42	0,59	0,56	0,45
60,229557	41,437153	0	0,09	0,18	0,41	0,70	0,69	0,59	0,29
61,343527	41,173593	0	0,09	0,14	0,26	0,58	0,69	0,58	0,47
61,346048	41,185082	0	0,11	0,23	0,34	0,68	0,76	0,75	0,58
60,165454	41,452203	1,1	0,38	0,41	0,53	0,72	0,61	0,39	0,39
60,274529	41,49585	1,1	0,08	0,16	0,32	0,69	0,68	0,61	0,36
61,316065	41,180542	0,8	0,20	0,09	-0,13	0,71	0,82	0,76	0,54
61,364419	41,195623	0,6	0,09	0,17	0,23	0,61	0,72	0,73	0,63
61,137083	41,30392	0,9	0,13	0,20	0,28	0,51	0,61	0,69	0,62
60,81434	41,484459	0,06	0,11	0,33	0,55	0,83	0,80	0,74	0,42
60,176926	41,451756	0,5	0,08	0,18	0,30	0,68	0,77	0,57	0,41
60,166802	41,439742	0,6	0,20	0,40	0,42	0,72	0,57	0,49	0,35
61,332413	41,160824	0,95	0,13	0,17	0,17	0,49	0,67	0,65	0,49
60,83092	41,47796	0,06	0,12	0,28	0,56	0,86	0,82	0,61	0,36
60,153405	41,537102	1,08	0,09	0,20	0,32	0,72	0,70	0,55	0,45
60,389864	41,495153	0,9	0,27	0,25	0,32	0,42	0,56	0,50	0,37
60,271987	41,493875	0	0,11	0,25	0,58	0,83	0,73	0,64	0,40
60,221945	41,522875	1,05	0,08	0,15	0,25	0,74	0,74	0,51	0,25

60,215673	41,514981	0,6	0,08	0,10	0,20	0,81	0,65	0,56	0,39
60,83208	41,45763	0,6	0,09	0,23	0,53	0,81	0,73	0,49	0,38
60,81387	41,48339	0,6	0,69	0,60	0,15	0,72	0,82	0,73	0,58
60,211242	41,519973	1,7	0,15	0,22	0,47	0,68	0,65	0,59	0,38
60,274887	41,518151	1,15	0,08	0,11	0,23	0,73	0,82	0,66	0,30
60,425868	41,493033	1,6	0,09	0,15	0,30	0,74	0,75	0,63	0,29
60,26618	41,476054	1,8	0,09	0,18	0,27	0,70	0,70	0,54	0,38
61,327076	41,19297	0	0,07	0,12	0,28	0,66	0,73	0,62	0,50
61,300251	41,206453	0,7	0,13	0,26	0,44	0,64	0,66	0,62	0,38
60,82429	41,45247	1,4	0,10	0,32	0,61	0,85	0,80	0,73	0,52
60,83372	41,4697	1,3	0,75	0,52	0,18	0,76	0,83	0,75	0,66
61,283375	41,174451	1,2	0,08	0,15	0,29	0,64	0,72	0,65	0,48
61,27833	41,164944	1,2	0,14	0,16	0,09	0,60	0,77	0,73	0,53
61,255854	41,166856	0	0,16	-0,07	0,36	0,79	0,80	0,78	0,62
60,191357	41,526011	1,6	0,07	0,11	0,15	0,68	0,77	0,72	0,47
60,18538	41,444772	0,8	0,10	0,23	0,41	0,68	0,75	0,61	0,38
60,117624	41,536636	0,7	-0,25	-0,01	0,50	0,79	0,50	0,28	0,24
60,208596	41,526628	0,06	0,34	0,25	0,31	0,52	0,69	0,68	0,46
60,342593	41,499146	1,4	0,12	0,17	0,34	0,81	0,77	0,69	0,40
60,148289	41,443473	0,6	0,14	0,16	0,33	0,72	0,71	0,62	0,36
60,235684	41,518625	1,3	0,10	0,24	0,38	0,63	0,71	0,66	0,42
60,237704	41,518091	1,7	0,08	0,12	0,20	0,51	0,62	0,62	0,45
60,17257	41,543133	0	0,16	0,11	0,31	0,67	0,72	0,67	0,55
60,126424	41,518929	0	0,07	0,12	0,17	0,62	0,68	0,59	0,40
61,227974	41,173482	0,06	0,12	-0,21	0,04	0,63	0,67	0,67	0,50
60,167424	41,533476	0,01	0,12	0,17	0,28	0,50	0,52	0,46	0,38
60,387958	41,493642	0	0,10	0,17	0,55	0,77	0,66	0,58	0,40
60,339223	41,501772	0	0,23	0,42	0,42	0,51	0,51	0,47	0,28
60,233949	41,519375	1,58	0,09	0,16	0,27	0,78	0,78	0,71	0,46
60,232167	41,519792	0,1	0,09	0,17	0,33	0,65	0,68	0,62	0,47
61,223071	41,198745	0,01	0,13	0,38	0,52	0,74	0,81	0,75	0,58
61,223059	41,198745	0	0,13	0,38	0,52	0,74	0,81	0,75	0,58
61,244865	41,192481	1,3	0,12	0,21	0,36	0,51	0,45	0,47	0,45
61,315285	41,16645	0	0,18	-0,22	0,32	0,81	0,83	0,71	0,41
60,83035	41,4532	1,45	0,10	0,38	0,65	0,85	0,80	0,66	0,48
60,843	41,45348	1,3	0,11	0,26	0,50	0,79	0,72	0,56	0,41
60,139524	41,507456	0	0,13	0,20	0,33	0,60	0,70	0,63	0,43

60,1409	41,506874	1,2	0,29	0,33	0,31	0,39	0,58	0,51	0,39
60,129036	41,507308	1,4	0,06	0,09	0,12	0,46	0,71	0,59	0,33
60,153128	41,500468	0,1	0,08	0,19	0,39	0,77	0,75	0,66	0,50
60,119006	41,507709	1,4	0,18	-0,07	0,53	0,79	0,77	0,66	0,49
60,12083	41,507868	0,09	0,15	-0,17	0,41	0,76	0,78	0,65	0,51
60,135445	41,514538	0,09	0,08	0,26	0,48	0,77	0,72	0,62	0,44
60,136898	41,514166	0,05	0,18	0,32	0,54	0,79	0,69	0,61	0,43
60,138304	41,513873	0	0,14	0,31	0,56	0,83	0,74	0,66	0,46
60,146836	41,510944	0	0,13	0,18	0,34	0,79	0,70	0,63	0,45
60,140922	41,515088	0,08	0,11	0,13	0,16	0,47	0,65	0,59	0,36
60,274868	41,516786	0	0,10	0,26	0,56	0,87	0,80	0,61	0,35
60,268524	41,455345	0	0,18	0,15	0,34	0,79	0,76	0,53	0,27
60,15296	41,441007	1,3	0,17	0,13	0,22	0,57	0,71	0,59	0,43
60,193499	41,562584	0	0,11	0,25	0,35	0,58	0,64	0,55	0,48
60,203067	41,561912	1,5	0,10	0,16	0,22	0,66	0,63	0,47	0,31
61,220686	41,20038	1,5	0,20	0,35	0,51	0,53	0,55	0,57	0,45
61,221629	41,201162	1,8	0,20	0,41	0,51	0,73	0,72	0,68	0,54
61,223577	41,175122	0,1	0,08	0,10	0,09	0,33	0,73	0,71	0,65
61,300236	41,180076	0,01	0,13	0,25	0,28	0,64	0,71	0,68	0,44
61,334058	41,157139	0,5	0,08	0,19	0,33	0,71	0,68	0,68	0,60
61,235815	41,177185	0,01	0,11	0,18	0,34	0,59	0,68	0,69	0,58
61,221611	41,175917	0,1	0,10	-0,17	0,15	0,62	0,77	0,57	0,31
61,259075	41,177817	1,1	0,08	0,14	0,24	0,55	0,67	0,53	0,35
61,127529	41,237773	1,3	0,13	0,16	0,34	0,73	0,75	0,54	0,58
61,127542	41,237789	0,5	0,13	0,16	0,34	0,73	0,75	0,54	0,58

Data obtained from meteorological stations installed in experimental fields

Hygrometric indicators in the field of Davron farm (No. 1), Khiva district, where the research was carried out

Month	Decades	Temperatura		Moisture		The number of larvae per bush / piece
		Average	Maximum	Average	Maximum	
May	10	21.5	35	34	64	0
May	20	23.1	40	38	66	0
May	30	24.3	37	36	46	0
June	10	26.5	36	34	48	0
June	20	26.7	36	34	49	0
June	30	29	38	36	75	0
July	10	32.6	43	38	58	0
July	20	26.9	37	38	66	0
July	30	29.3	41	36	68	0
August	10	29.9	40	42	71	0
August	20	24.5	33	42	67	0
August	30	25.1	37	60	86	0
Average		27	37.5	39.3	63.1	0

Hygrometric indicators in the field of Davron farm (No. 2), Khiva region, where the research was carried out

Month	Decades	Temperatura		Moisture		The number of larvae in 1 bush / piece
		Average	Maximum	Average	Maximum	
May	10	22.6	32	36	60	0
May	20	23.5	38	36	56	0
May	30	25	36	34	60	0
June	10	22.8	35	39	54	0
June	20	25.5	35	39	52	0
June	30	27	39	42	52	0
July	10	31.5	41	47	88	1.1
July	20	28	38	44	50	0.6
July	30	29	40	40	60	0.2
August	10	31	40	43	76	0.2
August	20	22	31	43	70	0
August	30	23	36	42	75	0
Average		26	37	40.4	62.5	0.175

Hygrometric indicators in the field of Davron farm (No. 3), Khiva region, where the research was carried out

Month	Decades	Temperaturalar		Moisture		The number of eggs is 1 per bush
		Average	Maximum	Avera ge	Maxim um	
May	30	27	37	48	86	0
May	10	23.5	36	54	80	0
May	20	24.5	35	46	81	0
June	30	28	38	63	80	0
June	10	33	42	62	85	6.4
June	20	28	37	66	88	4.2
July	30	28	39	42	72	1.3
August	10	29	38	45	85	0
August	20	22	30	44	71	0
August	30	21	35	45	70	0.
Average		22	36.7	51.5	79.8	0.07

Hygrometric indicators in the field of Bakhrom Makhfuza farm (No. 1), Gurlan district

Month	Decades	Temperatura		Moisture		Number of larvae (in 1 bush/ piece)
		Average	Maximum	Aver age	Maxim um	
May	10	22.5	30	34	68	0
May	20	24	36	38	71	0
May	30	22.5	35	35	74	0
June	10	22.5	34	39	52	0
June	20	24	34	40	64	0
June	30	27	36	38	68	0
July	10	33	40	48	80	0
July	20	27.5	36	54	71	0.1
July	30	29.5	38	56	78	0.01
August	10	26	36	60	85	0
August	20	20.5	29	64	85	0
August	30	24	33	66	73	0
Average		37.6	34.5	47.6	72.4	0.01

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Hygrometric parameters in the field of Bakhrom Makhfuza Farm (No. 2), Gurlan District

Month	dekadalar	Temperatura		Moisture		The number of eggs is 1 bush/piece
		Average	Maximum	Average	Maximum	
May	10	22.5	31	33	45	0
May	20	25.0	37	36	56	0
May	30	24	36	32	43	0
June	10	24.5	33	36	58	0
June	20	22.5	34	36	54	0
June	30	26.5	36	40	88	0
July	10	32	41	42	60	0
July	20	26	34	45	65	0.
July	30	29	36	56	88	0.
August	10	27.0	37	50	80	0
August	20	22.5	29	49	75	0
August	30	22.0	32	49	77	0
Average		25.3	34.6	42	66.5	0

Hygrometric indicators in the field of Bakhrom Makhfuza farm (No. 3), Gurlan district

Month	Decades	Temperatura		Moisture		Eggs (1 bush/ piece)
		Average	Maximum	Average	Maximum	
May	10	23	32	43	63	0
May	20	25	35	56	86	0
May	30	23	35	48	77	0
June	10	24	32	40	85	0
June	20	23	33	58	86	0.1
June	30	25	34	52	85	2.3
July	10	31	40	60	88	2.6
July	20	25	32	65	86	0.2
July	30	29	35	56	88	0
August	10	28	38	50	80	0
August	20	23	30	49	77	0
August	30	23	31	49	77	0
Average		22.5	34	52.1	84	0.51

Hygrometric indicators in the field under Sarapayon bioservice (No. 1) of Khanka district

Month	Decades	Tamperatura		Moisture		Number of eggs average (in 1 bush/piece)
		Average	Maximum	Average	Maximum	
May	10	21	34	34	75	0
May	20	22	33	36	72	0
May	30	24	34	38	78	0
June	10	23	30	56	41	0
June	20	23	30	58	52	0
June	30	28	34	57	86	1.1
July	10	29	38	64	85	2,4
July	20	25	34	66	84	1.3
July	30	28	35	68	75	2.2
August	10	27	36	52	67	0.1
August	20	23	32	52	72	0
August	30	24	32	51	74	0
Average		24.2	33.5	52.6	73.4	0.45

Hygrometric indicators in the field of Sarapayon Bioservice (No. 2) of Khanka district

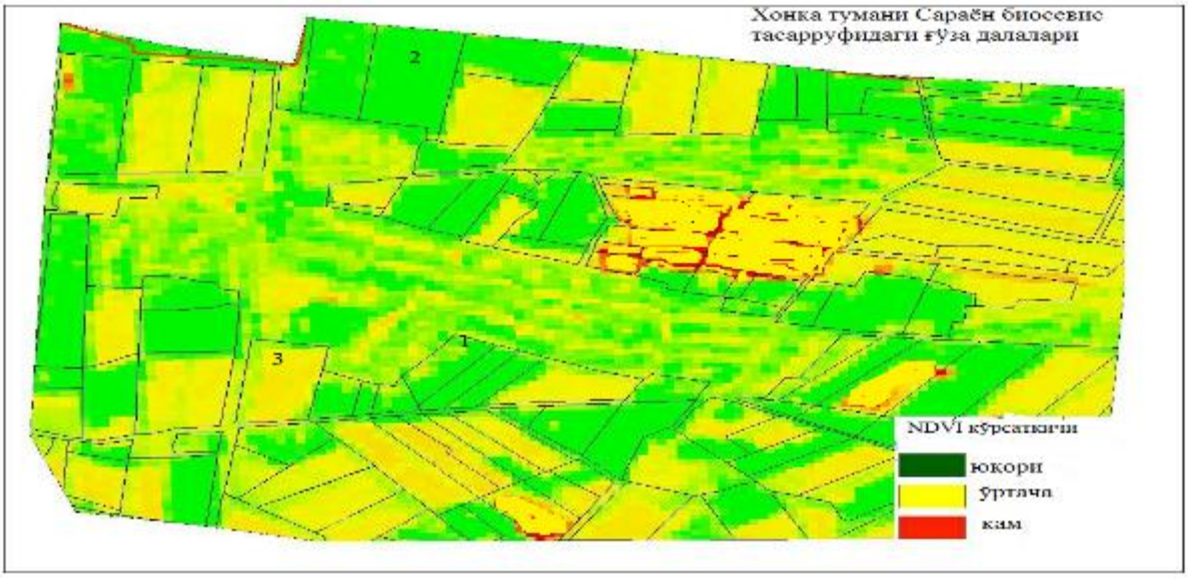
Month	Decades	Tempatura		Moisture		Number of larvae on average 1 bush/piece)
		Average	Maximum	Average	Maximum	
May	10	25	35	36	75	0
May	20	24	35	37	72	0
May	30	24	33	38	78	0
June	10	24	32	50	41	0
June	20	23	32	56	52	0
June	30	24	34	58	86	2.1
July	10	27	36	60	85	1.2
July	20	24	34	64	84	0.3
July	30	25	34	62	75	1.2
August	10	28	36	54	67	0.01
August	20	24	33	56	72	0

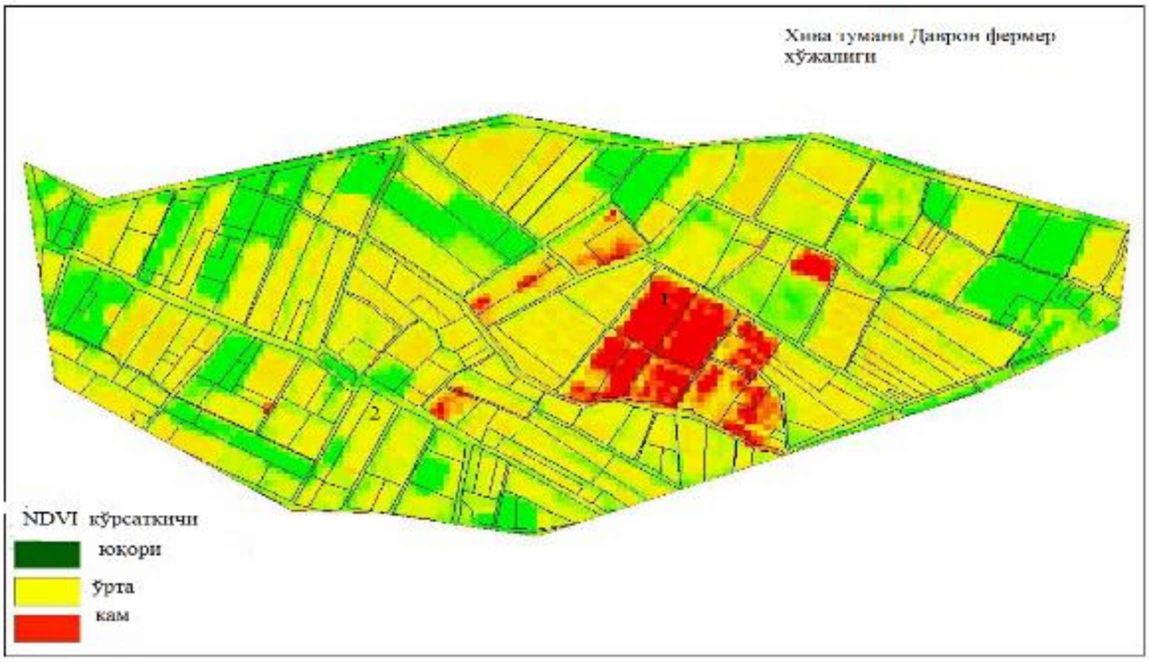
August	30	23	33	60	74	0
Average		22.6	33.9	52.5	73.4	0.40

Hygrometric indicators in the field under Sarapayon bioservice (№3) of Khanka district

Month	Decades	Tempatura		Moisture		The number of larvae is 1 bush/piece
		Average	Maximum	Average	Maximum	
May	10	24	33	33	75	0
May	20	23	37	37	72	0
May	30	24	34	36	78	0
June	10	26	36	33	41	0
June	20	28	34	34	48	0
June	30	30	36	37	86	0
July	10	32	39	33	85	0
July	20	27	35	39	74	0
July	30	31	39.4	37	75	0
August	10	30	37.8	41	67	0
August	20	25	34	43	72	0
August	30	26	37.6	41	74	0
Average		27.1	35.5	37	70.5	0

NDVI indicator in the experimental fields





1.2.3 Fields with meteorological stations

NDVI index in the fields studied

Field number	10-may	26-may	10-June	27-June	29-July	30-August	15-September	1-October	18-November
Cotton fields of Davron farm, Khiva district									
1	0.061907	0.115693	0.090758	0.118369	0.461457	0.706064	0.587449	0.329461	0.152667
2	0.12797	0.158635	0.197885	0.329583	0.596893	0.699931	0.628679	0.430481	0.173692
3	0.379769	0.459151	0.4139	0.526511	0.721016	0.614848	0.385089	0.3908	0.234863
Bahrom Makhfuza farm, Gurlan district									
1	0.080169	0.105217	0.108002	0.228655	0.730361	0.820997	0.656165	0.296056	0.259373
2	0.108428	0.124412	0.133305	0.159379	0.467099	0.651986	0.585767	0.359925	0.237052
3	0.095426	0.126661	0.257919	0.55958	0.874865	0.796667	0.612646	0.354214	0.368664
Khanka district Sarapayon bioservice									
1	0.114828	0.144492	0.252957	0.428943	0.805632	0.698637	0.443354	0.260216	0.285055
2	0.10042	0.1975	0.173096	0.549097	0.773403	0.655028	0.576049	0.40006	0.261178
3	0.293233	0.330932	0.33152	0.308854	0.388416	0.577027	0.509492	0.394417	0.163756

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№	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	Difference between maximum and minimum levels	Average annual salinity Salinity %
	Groundwater level (cm) and disease damage in the Khanka district											
	disease prevalence %					underground water level cm.						
1	0	0	0	0	0	186	179	191	160	191	31	0.7
2	0	0	0	8	8	186	179	126	193	150	67	0.8
3	0	0	0	6	8	215	226	165	230	184	65	1.2
4	0	0	4	6	10	230	245	260	212	240	48	0.8
5	0	0	6	8	16	254	256	170	241	184	86	0,9
6	0	0	4	6	6	220	265	198	231	210	67	0.7
7	0	14	18	26	58	146	270	153	266	208	124	0.8
8	0	0	22	24	28	184	263	224	218	230	79	0.6
9	0	3	14	26	32	186	287	210	188	240	101	0.8
10	0	0	0	24	36	224	241	136	234	187	105	0.9
11	0	4	6	10	10	240	163	169	187	163	77	1.3
12	0	0	7	10	10	231	177	245	214	163	68	1.2
13	0	0	14	26	26	194	124	126	193	135	70	0.9
Average	0	1,61	7.3	13.8	19.1	207.3	221.1	182,5	212,8	191.1	76	0.89
	Groundwater and disease damage in Urganch district											
14	0	0	12	30	46	170	300	250	140	250	130	0.6
15	0	0	8	36	52	110	254	240	254	250	144	0.8
16	0	0	0	12	34	210	228	133	223	125	95	0.8
17			24	38	42	184	240	110	238	154	130	0.9
18	0	0	0	16	28	174	176	123	218	210	95	0.6
19	0	2	2	8	38	110	208	172	204	115	98	1.0
20	0	0	2	8	10	164	202	175	196	162	38	0.7
21	0	5	8	28	39	230	134	165	210	140	96	0.7
22	0	0	0	6	8	216	218	174	224	180	44	0.5
23	2	4	4	4	4	223	182	201	190	223	41	0.8
24	2	4	8	14	24	230	243	158	205	218	85	0.9
25	0	2	10	14	18	230	166	196	230	205	64	0.7
26	6	10	24	38	48	156	286	240	156	218	130	0.5

27	0	0	0	0	0	210	236	225	240	199	41	0.6
	0,8	2.1	7,8	19,4	30,1	185,1	218,2	179,8	206,7	189,2	88,0	0.72
	Groundwater and disease damage in Khiva district											
28	0	10	24	28	34	243	142	142	214	164	101	0.9
29	0	0	0	38	56	274	270	116	213	143	158	0.7
30	0	0	0	40	60	292	161	143	248	184	149	0.8
31	0	0	0	8	8	288	200	236	263	214	88	0.9
32	0	8	8	16	19	146	233	246	233	218	87	0.6
33	0	0	8	14	6	246	160	243	218	214	86	0.8
34	0	14	21	46	56	240	126	246	130	230	114	0.7
35	0	0	12	16	24	180	158	261	254	218	103	0.6
36	0	0	0	0	0	291	258	266	274	264	33	0.8
37	0	4	14	24	36	276	174	241	178	274	102	0.8
38	0	0	2	8	10	286	313	258	306	280	55	0.5
39	0	0	0	18	22	289	248	216	289	234	73	0.7
40	2	8	14	32	66	316	320	191	296	187	129	0.9
41	0	0	18	36	38	294	296	298	284	278	18	0.7
42	0	0	0	0	0	194	176	194	194	156	38	0.6
43	0	0	0	0	0	223	241	210	242	210	32	0.5
44	0	0	14	46	56	248	142	263	241	266	106	0.8
45	0	10	16	56	64	296	130	164	292	174	166	0.7
46	0	0	6	6	10	314	218	296	294	298	96	0.6
47	0	2	4	4	8	321	288	288	294	298	33	0.6
48	0	0	34	36	38	263	142	164	168	183	121	0.7
49	0		14	22	36	240	240	146	215	167	94	0.8
50	0	6	16	20	48	310	312	163	297	169	149	0.8
Average	0.09	2.81	9,78	22,3	30,2	263,9	215,1	217,0	245,1	218,4	92,6	0.73

12- app

The process of conducting a seminar on the implementation of research results and cooperation in the region

Seminar on teaching GIS technology with provincial district inspectors

To work together with active biolaboratories in the region

A workshop was organized to work together with active biolaboratories in the region.

Interview with the governor of the region on the topic

The director of the scientific production center of the Khorezm region together with the farmers in the experimental fields

Renet Simerenko Economic efficiency of chemical drugs in protection of apple variety from cytosporosis disease

№	Indicator	Control	Fundazol	Bordeaux liquid	Impkt	Topsin-M
1	Productivity ts/ha	90.2	110.2	108.7	109.2	110
2	The saved yield, ts/ha		20	18.5	19	19.8
3	A liter of the drug per hectare		1	150	0.2	0.3
4	The total price of the drug per hectare is soum		220000	70000	70000	130000
5	Soums for the service and tractor for protecting one hectare		41400	41400	41400	41400
6	Total expenditure on protection, ha/soum		261400	111400	111400	171400
7	The cost of collecting and transporting additional crops, ha/soum		30000	20000	30000	30000
8	Total cost of plant protection and additional crop harvesting, ha/soum		291400	131400	141400	291400
9	Total cost of crop cultivation, ha/soum	14010000	14010000	14010000	14010000	14010000
10	Total: spending, soum	14010000	14301400	14141400	14151400	14301400
11	The total price of the crop obtained per hectare	18040000	22040000	21740000	21840000	22000000
12	Value of additional harvest, soums/ha	0	4000000	3700000	3800000	3960000
13	Conditional net profit sum, soums	4030000	7738600	7598600	7688600	7698600
14	Economic efficiency compared to control, ha/sum		3708600	3568600	3658600	3668600
15	Compared to the model, ha/soum		140000		90000	100000
16	Receipt of spent 1 soum, once	1.28	1.57	1.55	1.55	1.57
17	Profitability (profitability) of the protection method,%	128.7651677	157.3162027	155.1748751	155.888651	157.0306924

KHORAZM MAMUN ACADEMY

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USE OF GIS TECHNOLOGIES IN PLANT PEST AND DISEASE CONTROL SYSTEM

monography