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The Influence of Age-Related Changes on the Parasite Fauna of Silver Carp (*Hypophthalmichthys Molitrix* Val., 1844)

Abstract

The article analyzes the changes in the parasitic fauna of the silver carp depending on its age. Studying the morphometric dimensions of the silver carp and conducting studies on its impact on the parasitic fauna allows us to track the development of diseases in their hosts. As a result of the studies, six species of parasites belonging to different taxonomic groups were recorded in the fish. The fish were conditionally divided into three groups according to age: the +1 group (body size up to 10 cm), the +2 group (between 10 and 20 cm), and the +3 group (greater than 20 cm). It was found that a small number of parasite species are observed in the +1 groups of fish. They are mainly infected with parasites that lack an intermediate host. As they grow, they are infected with new parasites. In terms of species, the most infections (five species) are observed in fish of the third age group. A decrease in fullness is observed in fish that are more infected with trematode larvae.

Keywords: *silver carp, parasite fauna, age of fishes, fullness*

Introduction

The territory of the Republic of Azerbaijan has various water bodies suitable for the development of fishing. Therefore, in recent years, lake fishing has been widely used to meet the growing demand of the population for fish products. Fishes that are considered more favorable than other fish species due to their rearing conditions, endurance and food requirements are brought to the republic for artificial lake fishing.

In order to achieve high productivity in lake fishing, the parasitological situation must be constantly monitored and thoroughly studied. Sometimes there is a possibility of parasites not belonging to the local fauna being introduced through imported fish. What makes the parasitological study of such fish relevant is that the parasites they bring to the basin have certain effects on the ecological characteristics of the local parasitic fauna. All these allow us to foresee the process of preventing the damage that parasites can cause to farms.

Research

One of the main fish used in lake fishing in Azerbaijan is the silver carp (*Hypophthalmichthys molitrix*). Ichthyopathological monitoring conducted on such fish grown in fish farms allows us to find more effective methods in combating parasites. Studying the morphometric dimensions of fish

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and analysing their impact on the parasitic fauna provides a basis for seeing how diseases develop. Therefore, obtaining such information in fisheries helps plan the density of fish breeding and prevent the entry of disease-causing parasites into the farm. It should also be noted that in recent years, studies have been carried out on the changes in the parasitic fauna of a number of commercial fish in the country depending on various ecological factors (Ibrahimova & Rzayev, 2018; Seyidli et al, 2021, 2022, 2023; Nasirov et al., 2024). There are also a number of literature on the study of parasites of silver carp in the country (Abdullayeva, 2010, 2012; Suleymanova, 2004). Parasites of the mentioned fish have also been studied in other countries (Alam et al., 2012; Mhaisen & Al-Rubaie, 2016; Yakhchali, 2018; Thakur et al., 2020). Concidering all these, in the present research work, a morphobiological and parasitological analysis of the silver carp reared in the lakes of the Mingachevir scientific and experimental laboratory was carried out.

Material and methods

Materials for the study were collected from 50 silver carp caught in the lakes in the territory of the Mingachevir scientific and experimental laboratory. To study the parasitological state of silver carp with different morphometric dimensions, they were divided into three approximate age groups according to body size: fish up to 10 cm were classified into age group +1, fish 10-20 cm were classified into +2, and fish over 20 cm were classified into age group +3. Analysis of materials on age, growth, and other morphometrics (total size, mass, and Fulton fullness) was carried out based on the Pravdin method (Pravdin, 1966), and the collection, fixation, storage, and processing of parasitological material were carried out based on generally accepted methods (Dogel, 1933; Bykhovskaya-Pavlovskaya, 1985; Markevich, 1950; Gusev 1983; Shigin 1986). Freshly caught fish, and sometimes preserved in 4% formalin solution were used for the study. MBS-1 binocular magnifier, Ergaval and MBI light microscopes were used for the work. Parasites collected from the hosts were identified based on the Key Books (Bauer, 1985, 1987).

Results and discussion

In the study area, six species of parasites belonging to different taxonomic groups were recorded in the silver carp - *Gyrodactylys* sp. (monogenean), *Diplostomum chromatophorum* (trematoda), *Contracaecum spiculigerum* (nematode), *Lernea cyprinacea* (crustacean), *Argulus foliaceus* (crustacean), *Anodonta cyrea* (mollusk). As can be seen from the table, the number of parasite species is fewer in younger age (+1) groups and they are mainly infected with parasites that lack intermediate hosts in their development. Only the larvae of the parasitic crustacean *A. foliaceus* and mollusk *A. Cyrea,* attached to the body surface, were recorded on them. These are ectoparasites and attach to the skin. The thin skin of young fish facilitates the attachment of these parasites. In +2 fish group, with the increase in body size, in addition to the *A. cyrea* species, three additional species (*C. spiculigerum, D. chromatophorum, L. cyprinacea*) also added to the parasitic fauna. Therefore, at this age group, ectoparasites predominate in fish. However, +2 year old fish are also infected with metacercariae of the trematode *D. chromatophorum,* whose cercariae are actively penetrating into eyes of host. Infection with these occurs when swimming near aquatic plants. In +1 and +2 year old fish, infection with the mollusk larva of *A. cyrea* is mainly observed. The main reason for the low number of parasite species among +1 year old fish is that their parasitic fauna is not yet fully formed in artificial lakes. As they grow older, they become infected with different groups of parasites.

Table

A number of parameters of the fish and detected parasites.

№	Total length (in cm)	Mass (in g)	Fullness	Parasites
1	6.1	5.6	2.5	-
2	4.8	3.6	3.3	-
3	6.0	5.6	3.2	-
4	6.5	5.8	2.1	-

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5	6.2	5.5	2.3	-
6	5.8	4.2	2.2	-
7	5.9	5.1	2.5	-
8	5.7	4.1	2.2	-
9	6.0	5.7	3.1	-
10	6.3	5.8	2.0	-
11	6.5	5.2	2.1	*A. cyrea*
12	6.6	5.3	2.2	*A. cyrea*
13	6.2	5.4	2.3	*A. cyrea*
14	6.7	5.8	1.9	*A. cyrea*
15	6.9	5.8	1.8	*A. cyrea*
16	6.2	5.1	1.8	*A. foliaceus*
17	6.7	5.9	2.0	-
18	12.5	23.5	1.2	-
19	11.3	20.1	1.4	*A. cyrea*
20	11.5	20.4	1.3	*A. cyrea*
21	12.3	23.2	1.2	*A. cyrea*
22	11.7	20.7	1.3	*A. cyrea*
23	12.0	22.9	1.3	*A. cyrea*
24	10.5	18.3	1.6	*A. cyrea*
25	11.2	20.5	1.5	-
26	10.3	18.2	1.7	*L. cyprinacea, A. cyrea*
27	11.1	19.6	1.4	-
28	9.5	12.6	1.5	*A. cyrea*
29	10.7	18.3	1.5	*D. chromaophorum*
30	10.1	18.0	1.7	-
31	11.2	19.9	1.4	-
32	10.2	17.8	1.8	-
33	10.5	18.1	1.6	*C. spiculigerum*
34	23.0	45.0	0.4	-
35	25.0	50.1	0.3	*D. chromatoporum*, *Gyrodactylus sp.*
36	24.5	50.0	0.3	*D. chromatoporum*
37	28.0	60.0	0.3	*D. chromatophorum*
38	22.0	45.0	0.04	*D. chromatoporum*, *C. spiculigerum, A. cyrea*
39	24.0	45.1	0.3	*D. chromatoporum, A. cyrea*
40	24.6	48.2	0.4	*D. chromatoporum*
41	25.0	50.2	0.3	*D. chromatoporum*
42	24.5	45.3	0.3	*D. chromatoporum*
43	25.2	50.1	0.3	*D. chromatoporum*
44	25.5	50.3	0.3	*D. chromatophorum*
45	24.8	45.9	0.3	*D. chromatophorum*
46	25.5	46.0	0.3	*D. chromathophorum*
47	23.6	44.8	0.3	*D. chromathophorum*
48	25.2	44.9	0.3	*D. chromatophorum*
49	54.3	103.2	0.1	*D. chromatophorum*, *Gyrodactylus sp.*
50	52.0	102.0	0.1	*D. chromatophorum*, *L. cyprinacea*

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According to the results of the study, the maximum number of parasites in the silver carp was recorded at the age of +3. Five species of parasites (*Gyrodactylus sp., A. cyrea, C. spiculigerum, D. chromatophorum, L. cyprinacea*) were detected in this age group. Here, unlike the +1 and +2 age groups, it was found that a monogenetic worm belonging to the genus *Gyrodactylus* also parasitizes. On the other hand, not only was the species diversity of parasites observed, but also the increase in the intensity of infection was determined. One of the main reasons for this is the increase in food selectivity of fish at different ages and also their belonging to different biotopes of water bodies. As the fish grow, their food requirements increase. At this time, infection increases in them, especially due to feeding on intermediate hosts of the parasite. However, parasites that infect through feeding on intermediate hosts are rare in the silver carp. Only *C. spiculigerum* nematode, whose intermediate host is crustaceans is found. This shows that although the diet of the silver carp is composed of phytoplankton, sometimes there is variation in the diet. There is also a number of literature on the change in the parasite fauna depending on the age of the fish. Thus, the parasitic fauna of Caspian salmon (*Salmo trutta caspius*) and rainbow trout (*Salmo gairdneri*) bred in the Chukhur-Gabala and Chaykend fish farms in the country was studied depending on the age. It was found that, as in the silver carp, infection with parasites is higher in salmon and trout at older groups (Mikayilov et al., 2013, 2015a, 2015b).

We have also determined the dependence of fish parasites on their fullness. Information on the negative effect of metacercariae of the parasitic trematode *D. chromatophorum* of the *Diplostomum* genus on the abundance of fish was also obtained. When silver carp in third group are infected with diplostomum, a decrease in fullness is observed. Thus, the fullness is very high in +1 year old fish, where no parasites are found. However, as age increases and fish became rich in parasites, the fullness decreases. For example, if +1 year old fish have a fullness of 3.3 in the absence of parasites, this value decreases to 0.1 in conditions of high parasite intensity. Thus, a strong infection with parasites is observed in groups of fish with a low fullness level.

Conclusion

Based on the materials of fish groups +1, +2 and+ 3, which allow us to trace the development of the parasitic fauna of the carp, the maximum number of parasites (five species) is recorded at the age of +3. In fish of this age, not only the species diversity of parasites was observed, but also the intensity of infection increased. Most of the parasites recorded in the silver carp finish its life cycle without an intermediate host.

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A Study of the Toluene Hydrogenation Reaction in the Presence of Polymer/Nickel-Based Nanocatalysts

Abstract

The hydrogenation of aromatic compounds is widely utilized in modern industrial catalytic processes, which form the basis of motor fuel refining technologies. Researchers have determined that catalysts containing metals such as Ni, Co, Rh, and Ru ensure the selective progression of hydrogenation processes. Several Ni-containing synthetic polymer-based complex compounds have been synthesized. The identification of the obtained complexes was performed using various physicochemical analysis methods (XRD, SEM, EDS). Additionally, the catalytic properties of these complexes were studied in the hydrogenation of toluene. The catalytic properties of the synthetic polymer-based Ni-containing complex based on poly-N-vinylpyrrolidone (PVP) were investigated under mild conditions, with varying molar ratios of reagents.

Keywords: *unsaturated alcohols, oxidation, hydrogenation, toluene*

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Introduction

Hydrogenation of aromatics is an important precursor for the production of cyclohexane, which is an important reaction in the production of nylon-6,6 (Suleymanova, Zeynalov, Qulubayova, Guliyeva, Mammadova, Babayev, 2022; Shikhverdieva, Mammedova, Zeynalov, 2023; Alexey V.,et al.,2021). Hydrogen serves as a clean energy carrier and can be produced from renewable sources such as solar and wind energy. The toluene/methylcyclohexane (MCH) pair is a promising cyclic hydrocarbon system for the safe and efficient storage of hydrogen. In this approach, hydrogen is added to toluene (C_7H_8) through a hydrogenation reaction, converting it into MCH (C_7H_{14}), which can be transported using chemical tankers just like toluene. At the point of demand, hydrogen is released from MCH via a dehydrogenation reaction, with toluene being recovered for reuse. As a liquid organic hydrogen carrier (LOHC), this system is well-suited for large-scale storage and long-distance transportation, offering stability under ambient conditions and minimizing potential risks. The toluene/methylcyclohexane (MCH) system is not only reversible and highly selective but also free from carcinogenic by products. Additionally, it offers a relatively high hydrogen storage capacity (6.2 wt.%, 46.5 kg-H_2/m³), and the volatility range of its components allows for seamless integration with existing transportation infrastructure, including storage tanks and refueling stations. This advantage makes it more suitable for hydrogen storage and transport compared to other solid hydrocarbons. However, the hydrogenation of aromatic compounds, such as toluene, traditionally requires high temperatures and pressures, often exceeding 100°C and 50 atm H_2. Therefore, achieving hydrogenation under milder conditions remains a critical challenge, both for energy efficiency and environmental sustainability (Wang, 2021; Guliyeva, Suleymanova, Zeynalov, Qulubayova, Shikhverdiyeva 2023).

Research

The storage of hydrogen (H_2) using liquid organic hydrides plays a crucial role in harnessing renewable electricity from sources such as wind, solar, and hydropower (Bourane, Elanany, Pham, Katikaneni, 2016, Preuster, Papp, Wasserscheid, 2016). Methylcyclohexane (C_7H_{14}, MCH) is a promising candidate for chemical hydrogen storage. It enables hydrogen storage through the hydrogenation of toluene (C_7H_8), making it an efficient and viable option for energy applications.

$$\mathbf{C_7H_8 + 3H_2 = C_7H_{14} - 205\ kJ\ mol^{-1}}$$

This reaction has been widely studied in the petrochemical industry, with established infrastructure for the synthesis and transportation of MCH. Additionally, MCH offers a relatively high hydrogen storage capacity, with volumetric and gravimetric densities of 47 kg-H_2/m^3 and 6.1 wt%, respectively. It also possesses good transportability and relatively low toxicity, making it a promising option for hydrogen storage and distribution (Bourane, Elanany, Pham, Katikaneni, 2016).

Metal surfaces facilitate the hydrogenation of aromatic rings in arenes (Ari F.,2024). Catalysts containing metals such as Ni, Co, Rh, and Ru have been employed by researchers as promoters that ensure selective hydrogenation processes (Atsumi, Kobayashi, Xieli, Nanba, Matsumoto, Matsuda, Tsujimura, 2020) Nickel is widely recognized as a cost-effective metal for hydrogenation, delivering desirable results. Its significance in the industry stems from its electronic structure, which closely resembles that of platinum and palladium. Ni-based catalysts exhibit high activity when the $C_6H_5CH_3$:H_2 ratio is greater than 3. In contrast, the activity decreases sharply when the ratio is lower than 3, which is not considered a favorable condition for the hydrogenation of toluene. According to the results of the analysis of literature, in recent years, nickel metal, which has a low economic cost, has been widely used in the production of selective catalysts for the effective implementation of catalytic hydrogenation processes of hydrocarbons (Atsumi, Kobayashi, Xieli, Nanba, Matsumoto, Matsuda, Tsujimura, 2020, Cui, Ishii, Tsujimura, Ttaniguchi, Hashimoto, Nanba, 2019). Catalyst tests using toluene as a model compound showed that the surface properties

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of the modifier, especially surface area, pore volume, and pore diameter, affect the performance of the catalysts (Shuwa, Jibril, Al-Hajri, 2017).

Experimental section

Description of the device used for the hydrogenation process of Toluene

A flow laboratory apparatus was used to carry out the hydrogenation reaction of toluene. The operating principle of this apparatus can be divided into three stages (Ari, 2024):

1)Preparatory section 2)Catalytic section 3)Chromatographic section

The first section consists of a system designed for hydrogen delivery:

The required hydrogen flow was supplied from a suitable cylinder (1) and regulated by a two-chamber reducer (3). Gas pressure stability was ensured using a low-pressure regulator (2). Columns (4) filled with activated carbon, silica gel and molecular sieves were used to purify the hydrogen used as a hydrogenating agent from other impurities. Precise regulation of gas flows was carried out using sensitive regulating valves (5) calibrated with a capillary rheometer (7). The specified amounts of H_2, catalyst and toluene are mixed in the reactor (8) by means of a magnetic stirrer (11, 12) with a furnace. The reaction products and unreacted toluene leaving the reactor pass through a counter cooler (9), a certain part of which condenses and returns to the reactor, while a part of the steam is collected in a cooled trap, and finally the unreacted hydrogen passes through the trap and is released into the atmosphere. After the start of the reaction, a sample of the reaction products is taken from the sampling loop every 60 minutes for analysis (Bykov, Demidenko, Nikoshvili, Sulman, Kiwi-Minsker, 2021).

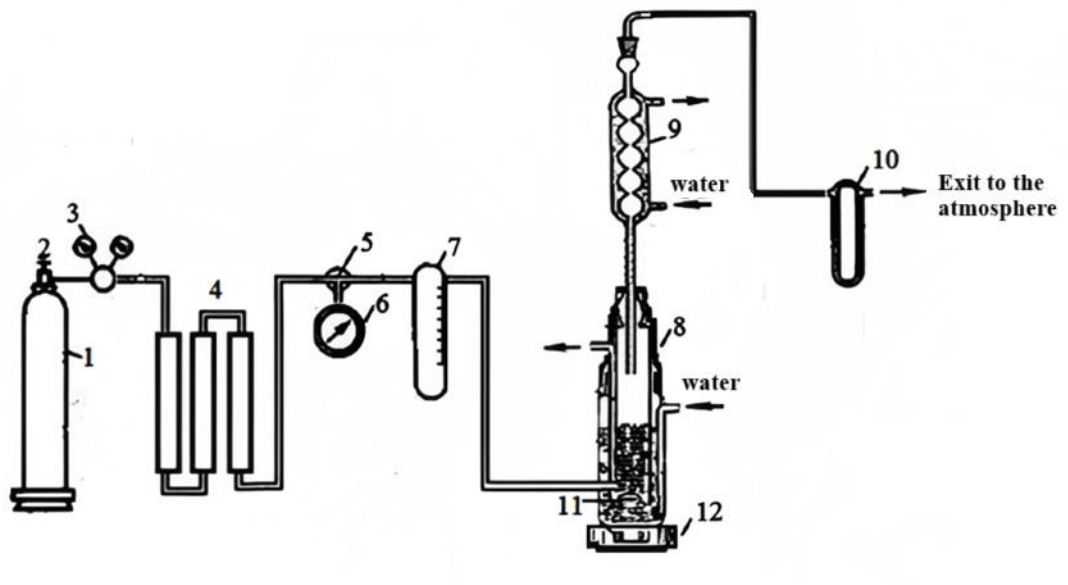

Figure 1. Schematic diagram of the assembled device for the hydrogenation reaction of toluene

1.Hydrogen cylinder
2.Low-pressure regulator
3.Two-chamber reducer
4.Gas purification columns
5.Gas sensitive regulating valve
6.Manometer
7. Capillary rheometer
8. Reactor
9. Condenser
10. Reaction products collector
11 and
12. Magnetic stirrer with stove

The hydrogen and nitrogen consumption entering the measuring column of the chromatograph (Agilent 7890B HP-5 column), at a gas carrier rate (N_2 and N_2) of 1.2 ml/min and a pressure of 5.41 psi (pounds-force per square inch), is determined. Before carrying out the reaction, the chromatograph is adjusted according to the procedure to be carried out. After determining the

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normal operating mode of the chromatograph and the required gas flow rate (N_2, H_2), the sample taken from the holder is manually introduced. The reaction products and unreacted toluene leaving the reactor are collected in a cooled reaction products collector, while the unreacted hydrogen and gases produced as a result of the reaction pass through the trap and are released into the atmosphere. After the start of the reaction, a sample of the reaction products from the sampling loop is fed to the chromatograph for analysis every 60 minutes.

Results and Discussion

In the research work, polymer complexes containing nickel as a catalyst in the hydrogenation reaction of toluene were synthesized. To obtain a nickel-polymer-based nanocomposite, nickel salts were immobilized into the polymer matrix by a chemical method. A synthetic polymer PVP and various percentages of Nickel metal (5,10,15%) were used as carriers. It has been found that, depending on the structure of the carrier and the amount of metal, it is possible to obtain small-sized nanoparticles (10-60 nm) in immobilized complexes. The sizes of the nanoparticles were determined by the Dynamic Light Scattering (DLS) method. The successful implementation of the metal immobilization process into the polymer was proven by the X-ray Diffraction (XRD) and Scanning electron microscope (SEM) analysis methods (Rahimli, Mammadova, Tagiyev, Zeynalov, Ismayılova, Babyev, 2025).

The hydrogenation reaction of toluene was carried out under mild conditions, with different molar ratios of $C_6H_5CH_3$:H_2. The products obtained from the reaction were analyzed on an Agilent 7890 B gas chromatograph. The effect of reaction time on the selectivity (relative to methylcyclohexane) of the hydrogenation reaction of toluene in the presence of a Ni-poly-N-vinylpyrrolidone catalyst was also studied. Thus, in the initial stage of the hydrogenation reaction (1.5-2 hours), a mixture containing methylcyclohexadiene, methylcyclohexene, methylcyclohexane, and toluene is obtained. It was found that the yield of methylcyclohexane was 11.3% as a result of the hydrogenation of toluene for 6 hours (40^0C) in the presence of PVP/Ni (10%) nanocatalysts (Parsafard, Peyrovi, Mohammadian, 2019).

Conclusion

In recent years, the acquisition of selective catalysts for the effective implementation of catalytic hydrogenation processes of aromatic hydrocarbons has attracted great interest. For this purpose, economically inexpensive nickel metal is widely used. In the presented work, a PVP/Ni-based catalyst was synthesized and it was determined that the yield of the target product was 11.3% at a temperature of 40^0C and a molar ratio of $C_6H_5CH_3$:H_2 of 1:3. Thus, the immobilized polymer-based nickel nanocatalyst shows high activity in the toluene hydrogenation reaction and maintains it over repeated cycles.

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Morpho-Anatomical Analysis of the Species *Origanum Vulgare* l. (*Lamiaceae* Lindl.)

Abstract

The article provides information on both constant and various structural indicators determined as a result of microscopic study of the taxon *O.vulgare* L.The scientific nature of the species and its distribution area are indicated. The medicinal, nutritional and ornamental properties of the plant are also thoroughly studied and analyzed. Despite the fact that plant classification is based mainly on morphological data, the anatomical method of studying vegetative organs of plants is of great importance in taxonomy and phylogeny. According to the anatomical analysis of *O.vulgare* L., the characteristics of its stem, petiole and leaf were determined. The plant's stem is quadrangular and has numerous collateral-type tufts. The leaves are amphistomatic, the stomata types are mesomorphic, the number of stomata on the lower surface of the leaf is greater than on the upper one. The epidermis of the leaf contains thyroid glandular hairs.The characteristic indicators revealed by microscopic studies were designated as diagnostic signs.

Keywords: *medicine, multiplicity, xylem, collateral, phloem*

Introduction

Recently, due to the increasing anthropogenic impact on the natural environment, there has been a significant reduction in the areas occupied by populations of medicinal plants, and often their complete disappearance. One of these plants is *O. vulgare* L. of the *Lamiaceae* Lindl. family. There are 20 species of the genus *Origanum* L. in Europe and Western Asia, 3 in the Caucasus, and 1 in Azerbaijan. It is widespread in all areas of our country, from the foothill zone to subalpine meadows. It is a perennial herbaceous plant, with rhizomes that develop horizontally. Its leaves are oblong-ovate, with short petioles. Small pink flowers are collected in panicle inflorescences. The stem is 30-70 cm high and covered with small hairs. The plant blooms in June-August, and its fruits ripen in September-October (Figure 1)

Figure 1. Appearance of the taxon *O. vulgare* L. in the natural population:
A-general appearance; **B**- appearance of flowers

The homeland of *O. vulgare* L. is the Mediterranean. It grows almost throughout Europe, the Caucasus, Kazakhstan, Georgia, Central and Asia Minor, North America. *O. vulgare* L.is a

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universal crop, it is used in a variety of areas as a medicinal, essential oil, spicy-aromatic and ornamental plant (Askerov, 2016)

Research

The leaves, stems, flowers and essential oil of the plant are used for medicinal purposes. As a medicinal plant, *O. vulgare* L. is included in the pharmacopoeias of many countries. The medicinal raw material is the herb of oregano - the upper part of the shoots with flowers and leaves. It contains 0.07-0.2% essential oil, tannins (up to 20%) and bitter substances, flavonoids, ascorbic acid, pigments, phytoncides, microelements (molybdenum, cobalt, zinc, etc.). The seeds contain up to 30% fatty oil, which is of interest to the pharmaceutical industry. It has been experimentally proven that preparations of this plant have a calming effect on the central nervous system, and also increase the secretion of the digestive and bronchial glands, intestinal peristalsis. Its preparations normalize the processes of fat breakdown, have a pronounced antispasmodic, choleretic, analgesic, antiallergic effect. Water infusions of the herb are used internally as a sedative for neuroses, insomnia, as well as for gastritis with reduced secretory activity, cholecystitis, anorexia, chronic enterocolitis, as an antipyretic; for inflammation of the respiratory tract, bronchial asthma. It relieves stomach spasms, prevents nausea and vomiting, has an anticonvulsant effect. *O. vulgare* L. preparations are also effective in the form of balms and lotions for massage (Damirov, Prilipko, Shukurov, Kerimov, 1988).

In a number of countries (France, Germany, Denmark, Norway, Poland, Austria, India, USA) *O. vulgare* L. is introduced as a medicinal plant. Since ancient times it has been popular in the countries of Southern Europe (Italy, Spain), as well as on the American continent - in Mexico - as a spice. Fresh and dried herb is used as a spice, known throughout the world under the name "oregano" or "pizza spice". The herb of the plant is added to spaghetti, salads, sausages, vegetable and egg dishes, cheeses, soups and sauces. It is also used when frying meat in the oven and on the grill, as well as for stewed and boiled meat, when preparing kvass, canned food, when pickling cucumbers, mushrooms and tomatoes. Buns, gingerbread and flatbreads are baked with it. People call *O. vulgare* L. tea a health drink.

The above-ground part of the oregano plant has coloring properties: orange-red dye for dyeing wool is obtained from the flowers, and black dye for cotton can be obtained from the grass with the addition of iron sulfate. *O. vulgare* L is a good honey plant, it gives a lot of nectar. *O. vulgare* L. is a vitamin-rich plant; in addition to oil, the leaves contain carotene and vitamins C, B_1, B_2.*O.vulgare* L.is a good ornamental plant. It is used in a garden of aromas or in a French-style vegetable garden, where flowers, vegetables and spices coexist in one bed (Angiosperm Phylogeny Group, 2016).

Materials and metods

For the purpose of the study, *O. vulgare* L. plant was taken from the nature of Goygol region territory. The systematic position of the species was clarified using the APG IV (2016) and World flora online databases (World Flora Online, 2020).

Phenological observations were conducted to study its anatomical features. The stem, petiole and leaf of the plant growing in natural conditions in the area were taken after reaching full morphological maturity. The aim of our study is to determine the anatomically permanent morpho-anatomical features of the *O. vulgare* L. taxon. After the vegetative organs of the plant were fixed with 70^0 alcohol, temporary sections were prepared according to the generally accepted anatomical method. The terminology of Esau N., N.A. Aneli was used for terminology and anatomical descriptions. Anatomical images were taken with a light microscope (Aneli,1955; Ezau, 1980; Lotova, 2005). During the preparation of temporary preparations, the material was freshly cut and placed in glycerin. The thinnest sections were transferred to a clean watch glass, and a small amount of watercolor solution was added to it using a pipette (Algan &Toker, 2004). After a few minutes, the section was washed repeatedly to remove the dye and observed under a microscope. The prepared anatomical preparations were examined under a BLM-210 LCD digital (modern microscope) microscope. Reagents, dyes, and auxiliary methods were used for the preparation of preparations and the determination of structural elements. To make the color of live preparations transparent, glycerin was used by adding two parts of glycerin to one part of water (Alexandrov, 1966; Gumbatov, 2017) Ethnobotanical methods were used during observations (Martin, 2004).

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Results and Discussion

Anatomical analysis of the stem of *Origanum vulgare* L. The trunk has a quadrangular structure in cross section. It is surrounded by a row of epidermal cells from the outside. The surface of the epidermal is covered with cuticle. The outer sheath of the epidermal is thickened. 2-3 layers of chlorenchyma have formed from the epidermal cells inward. This has been formed as an adaptation to the lack of organic nutrients. Multilayered angular collenchyma has developed at the corners. The bark parenchyma is 5-6 layers. These cells are large, round in shape and rich in coloring matter. The conductive tissue is strongly developed. The phloem surrounds the xylem on all sides in the form of a belt. The water tubes in the xylem are arranged one after the other, forming numerous rows (48-50 pieces). Each row contains 5-6 water tubes. The water tubes are densely surrounded by xylem parenchyma. The phloem is composed of polygonal, small-sized cells. The cambium is 2-3 layers. The center of the stem is occupied by large core cells. These cells are small in size in the part bordering the xylem and gradually increase in size towards the center. Starch, dyes and other reserve substances are accumulated in the core parenchyma in the form of reserves. The angular collenchyma located at the corners, together with the xylem, gives the stem special strength. (Figure 2)

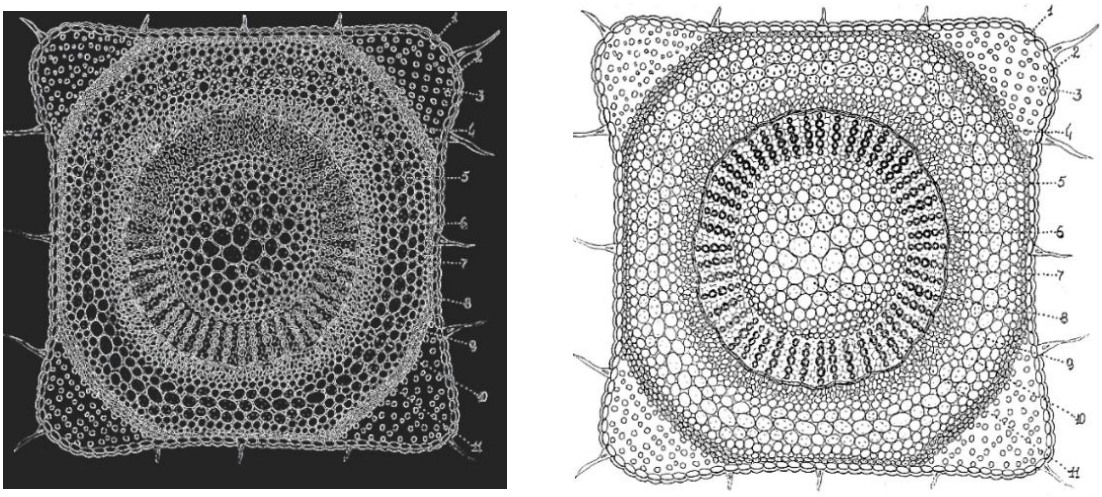

Figure 2 The stem cross section of *Origanum vulgare* L.: 1-cuticle; 2-epidermis; 3-angular collenchyma; 4-chlorphenchyma; 5- bark parenchyma; 6- phloem; 7- cambium; 8- xylem ;9- xylem parenchyma; 10- pith; 11- pigments

Anatomical analysis of the petiole of *Origanum vulgare* L. The petiole is circular in cross section on the lower surface and angular on the upper surface. It is surrounded by a layer of cuticle cells on the outside. The outer sheaths of the cuticle cells are thickened. The surface of the petiole is densely covered with simple hairs. Chlorenchyma consisting of 1-2 layers has developed from the cuticle inward. At first glance, the strong development of the main parenchyma in the petiole attracts attention. These cells are circular in shape and are loosely arranged. One large main ball is formed in the part facing the lower surface of the petiole, and two additional balls are formed in the part facing the upper surface (at the corners). In the balls, the phloem is directed outward, and the xylem is directed inward. Both the main and additional balls are surrounded by covering cells on the outside. In the xylem, water tubes (in the main ball) form rows (7-8 pieces) that are arranged one after the other. Each row has 3-5 water tubes. The water tubes are densely surrounded by polygonal parenchyma cells. The sheath of the water tubes is noticeably thickened. This, in turn, gives the plant considerable strength (Figure 3).

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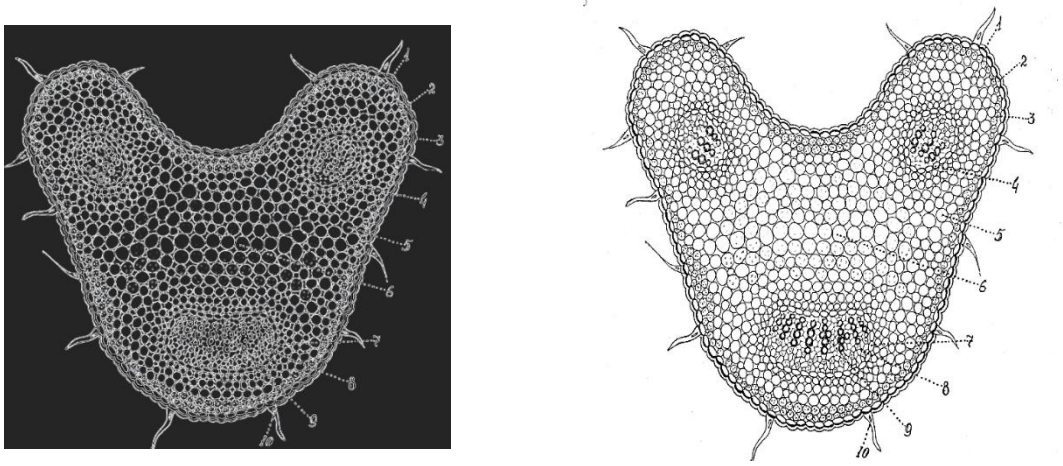

Figure 3 The petiole cross section of *Origanum vulgare* L: 1-cuticle ; 2- epidermis; 3-chlorenchyma; 4-extra corpuscle; 5- bark parenchyma; 6- pith; 7-covering cells; 8-phloem; 9- xylem; 10- hair

Anatomical analysis of the leaf of *Origanum vulgare* L. The leaf is dorsoventral in cross section. It is covered with a thick cuticle layer on both surfaces. The epidermis is single-layered. The upper epidermis cells are voluminous and their outer sheaths are thickened. Together with the cuticle, they constitute 40-45% of the epidermis cell. The spongy parenchyma is single-layered, rich in chloroplasts. The vascular bundles are collateral type. They are surrounded by one layer of surrounding cells from the outside. The xylem is directed towards the upper surface of the leaf, and the phloem is directed towards the lower surface. In the xylem, water tubes are arranged one after the other, forming rows. There are 5-6 water tubes in each row. The phloem is composed of 4-5 layers of cells. Sclerenchyma, composed of 2-3 layers of cells, has formed from the phloem outwards, which greatly increases its strength by giving elasticity to the leaf. Stomata are found only on the lower surface of the leaf. Studies have shown that as altitude increases in the mountainous zone, the stomata decrease in size, but their number increases. Changes occur in the epidermal cells with altitude, as their outer covering thickens, and the cuticle, together with the outer covering of the epidermis, makes up 40-45% of the epidermis. Such a structure should be considered a sign of the adaptation of plants to the harsh climatic conditions of the mountainous zone. Both surfaces of the leaf are densely covered with hairs.(Figure 4)

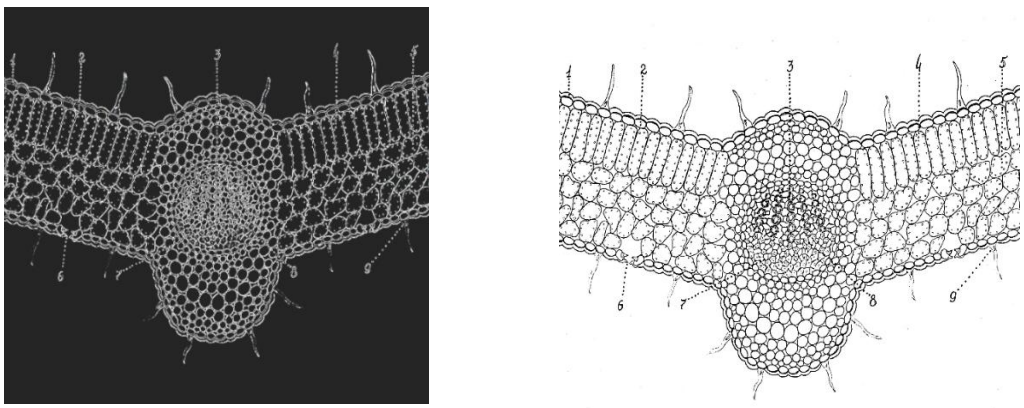

Figure 4 The cross section of the leaf of *Origanum vulgare* L: 1- cuticle; 2-epidermis; 3-xylem; 4-septal parenchyma; 5-spongy parenchyma; 6- stomata; 7-sclerenchyma; 8-phloem; 9-hair

Conclusion

Anatomical studies have shown that the leaves, stems, and flowers of the studied species contain dyes (black-dyeing substances). These dyes can be used to dye cotton and woolen products. These are the main diagnostic features of the species:

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➢ The stem has a quadrangular structure in cross section. Angular collenchyma consisting of 8-9 layers has developed at the corners.

➢ Chlorenchyma consisting of 2-3 layers has developed from the epidermis of the stem inwards.

➢ Dyes and other reserve substances accumulate in the bark and other core parenchyma of the stem.

➢ The conductive tissue in the petiole is characteristic only for that species in terms of its structure, shape and formation and can be used as a diagnostic sign.

➢ It is a cryoxerophyte according to the anatomical structure of the petiole. It is characterized by the formation of a dense hairy cover, thickening of the outer sheaths of the epidermal cells, the formation of chlorenchyma, strong development and dense arrangement of the main parenchyma.

➢ It is a cryoxerophyte according to the anatomical structure of the leaf. It is characterized by the dorsoventral structure of the leaf, thickening of the cuticle, the presence of stomata only on the lower surface of the leaf, dense coverage with hairs, etc.

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The Role of Physical-Geographic Factors in the Formation of the Forests of Lankaran Natural Region

Abstract

The role of physical - geographical elements in the forestation in the Lankaran essential region has been investigated. The special climate of the region, steamy and subtropic conditions, divergent relief forms and rich plant cover have created special nativeconditions for forest flora. The attendance of a dense hydrometry system and excessive annual precipitation and along with the biology variety of forests, form the essential for their distribution across the region. Also, the medium temperature in foothill and mountainous zones and changeable soil categories play the main role in the forest formation. The article converse about the formation of the Hirkan forest area in Lankaran region as a sum of the interconnection of geographical and physical components with each other, creating the essential special native landscape with both environmental and biologic value. As a sum of, the interactivity of physical geographical elements with each other has created surroundings for the formation of forest ecological systems with spesific and high ecological value in Lankaran zone.

Keywords: *physical, geographical, climate, biodiversity, landscape, forest, hydrographic*

Introduction

Lankaran natural region is considered one of the unique natural-geographic regions of Azerbaijan, differs from other natural regions in terms of its wide biological diversity and unique forest ecosystems. Many physical-geographical factors (climate, relief, soil, water network) play a special role in the formation of Lankaran's natural conditions and forest cover. The interaction of these physical-geographical factors has created the Hyrcania forest complex, which has an ancient history and is protected and preserved in the territory of Lankaran. Hyrcania forests are not only an ecological context, but also have significant aesthetic and scientific importance.

This article, in addition to scientifically analyzing the influence of physical and geographical factors on the formation of the unique forests of the Lankaran natural region, studies the important natural factors that influence the formation of this process and explains the impact of these factors on forest biodiversity. As a result, the main goal is to reveal the unique role of physical and geographical factors in the formation and protection of the forest landscape of the region.

Research

The Talysh Mountains and the Lankaran Lowland, located at the junction of the Talysh Mountains and the Caspian Sea, are well-known orographic units of the Lankaran natural physical-geographical region. The Lankaran Lowland, with a simple relief, narrows from north to south. The main forms of the unique relief in this area are the convex plains of the river confluences and smooth sea plains, as well as shallow depressions characteristic of some places. The mountainous part of Talysh is separated by three parallel ranges, the most important of which is the Talysh watershed range (Gomurkoy 2493 m, Gizyurd 2433 m, Shandangalasy 1816 m).

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The Talysh watershed range extends for 80 km from the Astarachay range in the south to the upper reaches of the Vilashchay in the northwest. The Diabar and Gosmalyan depressions of tectonic origin are located in the watershed zone of the Talysh Mountains. In the northwest of the watershed zone, the Peshtesar ridge parallel to it extends, which in many places, except for erosional valleys corresponding to the structure, merges with the Talysh Mountains and surrounding transverse ridges and is not so noticeable from an orographic point of view. These two ridges pass into the Bogrovdagh ridge in South Azerbaijan and extend to the Manjil gorge of the Giziluzan River. The third low mountainous ridge in the Talysh mountainous zone is the Burovar ridge with a length of 914 m (Burovar -914 m, Dizdoni 1056 m). The Burovar ridge intersects with the Vilashchay and Lankaranchay antecedent valleys. The Yardimli and Lerik depressions are located in the bosom of the Talysh Mountains. The wide eastern slopes are covered with numerous deep river valleys, while the western slopes facing the Ardabil depression of the Talysh range are short and slightly sloping, and are mainly dissected by erosional forms of temporary running waters. In the Lankaran natural province, the highland vegetation (flora) zonation begins with plain forests. In other mountainous provinces, this zonation begins with the desert-semi-desert and dry steppe vegetation zones of the plains and foothills. The development of vegetation cover mainly in the inner mountain depressions, in the Lankaran province, in accordance with the vegetation type of arid provinces in the highlands, is related to the interaction of the continental climate of the Iranian plateau.

Despite a number of valuable studies on vegetation, in the mid-40s of the XX century, the territory of Azerbaijan was still not covered by almost accurate geological and botanical studies. Until these years, punctual geobotanical mapping (scale 1: 25000, 1:100000) was carried out only in the south-east of Shirvan, in the central and south-western parts of the Mughan plain, in the Mil-Lankaran plain and in the Lankaranchay watershed. In more than 60% of the territory of Azerbaijan, the vegetation layer was studied only along the relevant routes. In this regard, in the 40s-50s and recently, a number of significant errors were discovered in the schematization of the vegetation of Azerbaijan by individual authors, as well as in the medium-small-scale vegetation maps. However, despite all these shortcomings, both during these years and in subsequent years, many useful research works on the flora of our Republic were produced.

The regional forests of Lankaran differ somewhat in plant species and forest forms compared to the forests of other mountainous zones of the Republic of Azerbaijan. These different features depend on the history of the formation and development of vegetation in the territory of Lankaran province, specifically on the fact that the region has more precipitation than other mountainous regions of our country, and on other factors. The territory of Lankaran is generally included in the ancient Hyrcanian province. Hyrcanian province itself, in comparison with the eastern part of the Caucasus and other regions, has preserved more relics of the 3rd period, creating the basis for the formation of semi-humid subtropical forests in the plains, foothills, and low-mountain areas.

According to the research of the Russian scientist L.I. Prilipko, one of the main characteristic features of the forests of the Lankaran natural region is the absence of other coniferous tree species here, except for yew (Taxus baccata) and juniper bushes. Another feature that distinguishes this type of forest from the humid and subtropical forests of Colchis is the weak development of evergreen shrubs, as well as their low species composition. The fact that 3 main types of evergreen shrubs (Hyrkan bizotu, Danaya, Hyrkan pırkali) grow in the Lankaran territory proves that the mountains and plains of Lankaran had a unique evergreen vegetation cover in the III period. Epiphytes in this area are relatively poorly developed (for example; bear's-foot trefoil), while lianas are well developed compared to epiphytes (maravca, gurma, dassarmaşığı), which is characteristic of low mountain and plain forests. The tree species that are widely distributed in the species composition of modern low mountain forests in the Lankaran region, which are classified as ancient tugai vegetation, include: Lankaran acacia, iron tree, Hyrkan fig, chestnut-leaved oak, velvet maple, heart-leaved alder, Hyrkan azat tree, Hyrkan boxwood, thick-leaved sedge, large-leaved sedge, and other tree and shrub species (Museyibov, 1998).

The highest points of the Talysh Mountains are the peaks of Gomurkoy (2493), Gizyurd (2433), Divanbil (981 m), Qala-Gırba (928 m), Vishnabad (848 m), and Ulyasi (828 m). The relief of the

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area, directed from west to east, noticeably descends, replacing both mountain slopes and foothills with slopes and lowlands. The reason for the formation of the Lankaran lowland is the rise of the Tertiary seabed, which at the same time leads to the widespread distribution of marine terrigenous and carbonate, volcanogenic, and volcano-sedimentary rocks. Denudation (destructive) formations are unique for the slopes in this area, and accumulative formations for the lowlands (Khishtova, 2021).

Since the moisture generated by the influence of the Caspian Sea is condensed through the Talysh Mountains, the amount of precipitation in the Lankaran lowland is high. In the areas covered by the reserve from 1000 m above the Caspian Sea to 20 m below sea level, the annual amount of precipitation varies around 900-1400 mm, which in turn covers the maximum amount of precipitation in the autumn months (712 mm, 51%), and the minimum amount in the summer months (166 mm, 11.8%). The evaporation process is 1.2-1.6 times less than the amount of precipitation of 750-850 mm, which means that the number of rainy days per year exceeds 90. When moving from north to south in the Lankaran natural physical-geographical region, an increase in the amount of precipitation falling on this area is observed. The amount of precipitation also depends on the increase or decrease in altitude. The amount of precipitation increases up to 500-600 meters above the Caspian Sea, and then decreases. This, in turn, leads to the gradual strengthening of the subtropical landscape as one moves south along the lowlands. In mountainous areas, the subtropical landscape is of great importance up to 800-900 meters, and boreal landscapes for higher areas. In the Lankaran-Astara region, the annual amount of precipitation varies regionally between 1200-1700 mm, which is the highest indicator for the territory of Azerbaijan and is one of the necessary factors in the development of forest vegetation (Yusifov, Hajiyev, 2004).

The small annual temperature range observed in subtropical climates leads to an extension of the vegetation period, which creates the basis for the intensive development of forest plants (Mammadov, 2004).

The snow cover in Lankaran depends on the altitude of the area and these indicators change every year. The snow density in the Talysh Mountains varies between 0.14-0.16. Yellow soils are characteristic of Lankaran region. On these types of soils, Hyrcanian forests rich in ironwood, oak, silk acacia and other tree species have formed and developed (Collection of scientific works of AzHveMEIB, 2019).

The high amount of precipitation in the Lankaran region is explained by the weakness of the evaporation process as a result of the high humidity of the air here. The high level of humidity of the air depends on the location of the area close to the Caspian Sea, and the fact that the cold air masses coming from the north and northeast are blocked by the mountain range surrounding the sea from the south. When analyzing the results of the existing materials of studies conducted on the durability and thickness of the snow cover in other regions, it was determined that the snow cover in most parts of the Lankaran region is unstable (Mahmudov, 2013).

The soils of the mountainous part of the Lankaran region have been studied for a number of purposes by V.R. Volobuyev, M.A. Salayev, G.Sh. Mammadov, M.P. Babayev, C.M. Jafarova, V.H. Hasanov, S.Z. Mammadova, C.A. Shabanov and other researchers. For this reason, a number of nuances are revealed in the works of V.J. Hajiyev, M.T. Jabbarov, B. Guliyev and other scientists related to the soils of the region. As noted in the map "Morphogenetic profile of Azerbaijani soils", "Modern classification of Azerbaijani soils" and "Ecological assessment of agricultural soils of the Lankaran-Astara natural, economic region", extensive information is provided on the soil types, subtypes, genera and species diversity, geographical distribution, genetic structure, color shades, and physicochemical aspects of the area. As a result of the conducted research, it was determined that the high mountainous part of the territory is formed by 3 types of soils, which are characteristic of vertical zonation: mountain-meadow, mountain-meadow-gozgyr, mountain-forest-brown, mountain-brown, and meadow-swamp (Aslanova, 2019).

M.T. Jabbarov (2000) notes that in the flora of Talysh, mountain-xerophyte vegetation is distributed at an altitude of 1400-1500 m above the Caspian Sea to 2500 m (in the summer pastures of Lerik and Yardimli regions). He also noted the widespread distribution of mountain-xerophytes

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at an altitude of 1700-2500 meters above sea level in the Zuvand and Diabar areas, as well as in the high mountain belt. In areas where the rocks of the Bozdag area consist mostly of sparse saline clays, specific phrygana groups resembling deserts occur, as well as in the arid forests (Gurbanov, 2024).

In the high mountainous areas of Talysh, relatively strong mountain-brown soils with a humus content of 6% to 10% are dominant. These types of areas are mainly alkaline, non-carbonate soils, and are of medium or heavy loamy, lumpy, granular, and lumpy-sandy in mechanical composition. On soils with soft upper layers, thyme, mixed lobular thyme, and various plant groups develop (Hajiyev, 2004).

A. Eyyubov (1968, 1975) emphasized that there are 6 agro-climatic regions within the borders of the Lankaran region, which differ from each other in terms of climatic environment:

1. Jalilabad-Gizilaghac;
2. Masalli
3. Lankaran-Astara;
4. Burovar-Siakar;
5. Lerik-Yardımlı;
6. Diman-Gizyurdu (Mammadova, 2003).

The characteristic features of the forests of these regions are rich in unique and endemic tree species. Specifically, these types of trees growing in the Talysh Mountains are known worldwide. Throughout history, the Lankaran lowland has been covered with Hyrcanian-type forests. However, as a result of human influence on nature, these types of forests have been destroyed and replaced by tea plantations, tangerine orchards and other agricultural areas. Along with several optimal fertility levels, part of the lands useful for agriculture in the Lankaran region have been subjected to erosion and salinization. As a factor that has a very striking effect on soil productivity, erosion can be compared only with sharp salinization. As a result of this effect, a number of soil properties and regimes have undergone sharp changes, negatively affecting the chemical, physical, and water-physical indicators of the soil (Aslanova, 2019). The greatest damage affects soil humus, which is an important integral element of productivity, as a result of which its quantity and reserves in the soil profile tend to decrease, and its composition deteriorates. At the same time, a decrease in other nutrients and a weakening of the biological activity of the soil are also observed. At very severe levels of erosion, the soil completes its natural-historical activity with the gradual washing away of the upper layer of the soil, usually with the emergence of lower horizontals consisting of parent rock to the upper layer. Scientists divide soils into four groups according to the degree of erosion: weak, medium, severe, very severe. As a result of research conducted in administrative districts (excluding Masalli district), it became clear that 15.4% of the lands of Lankaran useful for agriculture, or 43,261.3 hectares, have been subjected to erosion (Mammadov, 1997). As a result, the area of forest ecological systems has significantly decreased and their structure has been disrupted. Specific nature reserves such as the Hirkan National Park and the Gizilaghac Reserve have been created to protect forests. These areas are of great importance in protecting the rich nature of Lankaran (Aslanova, 2019).

Conclusion

The rich forest cover of the Lankaran natural region plays an important role in protecting the ecological balance, biological diversity of the region and ensuring soil fertility. Physical and geographical elements such as the diversity of landforms in terms of the totality of land forms, the subtropical nature of the humidity of the climate, the density of the hydrological network and the breadth of soil types have had a fundamental impact on the formation and spread of forests. However, despite all this, in recent decades, due to the expansion of agricultural areas, the increase of human impact and the large population, the decrease of forest areas, a change in their composition and the disruption of ecological systems have been observed. Such circumstances have led to increased vulnerability to soil erosion, degradation, desertification and climate change.

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In this case, scientific research of forest resources, assessment of physical-geographical nuances and preparation of a regional plan for intensive forest management are extremely relevant and important. The protection, restoration and sustainable use of forest cover in the Lankaran natural geographical region is of great importance in terms of ensuring both local ecological stability and national ecological security in general.

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The Studing of Additional Technological Feeding of White English Quails With Mineral substances and Vitamins

Abstract

İn this research was shown the additional technology of feeding White English quails with mineral substances and vitamins. The investigation work was held in Azerbaijan State Agrarian University's "The Educational center of quail breeding", in the department of "Anatomy and non-infectious internal diseases" and in some farms of Goygol and Shamkir regions, and also in some individual White English quails breeding farms. In food portion it must be special nutritious matters, organic matters and vitamins. It must be used the fullfilment of mineral matters widely. The lack of minerals destroyed exchange of matters and belowed the durable to illness. During our investigation work it turned out that the vitamins have great role in White English quails food. The White English quails can be given calsium, chalk, cockshells, crumbled lime and other minerals in addition. (these matters can be given only if there isnt any poisinous effects in them).

Keywords: *White English quail, mineral matters, calcium, phosphor, Aydag mineral, the dust of marble, vitamin, ash*

Introduction

In recent years, due to certain production indicators and several specific features, the development of Azerbaijani poultry farming has reached the world level. An important direction in the non-oil sector of Azerbaijan is the accelerated development of livestock farming. In the conditions of increasing market competition in recent years, livestock farming is impossible without the application of innovative technologies. First of all, this applies to poultry farming, which is the most rapidly developing, scientifically intensive and high-tech field. According to experts, today poultry farming is considered one of the most profitable of the country's livestock farming. Such effect occurs when a short time and minimal costs are required to obtain a commodity product (Hajiyev, Mirzayev, Mammadov, Iskanderova, Hajiyev, 2019; Mammadli, Shahmarov, 2018 & Mammadli, 2015).

Research

The efficient use of poultry farming, including quail farming, in Azerbaijan has led to the diversification of the economy and the development of the non-oil sector. Diversification of the economy, like all other sectors, has created favorable opportunities for the development of the quail farming sector. The transformation of Azerbaijan into a country exporting agricultural products has also been chosen as the main goal. To achieve this goal, our country has all kinds of opportunities, and most importantly, state support. In addition to being of exceptional importance as the next

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stimulating step in the agricultural sector, it will also lead to a significant increase in interest in the quail farming sector, and ultimately to the production of quail meat and egg products. As can be seen, the attention and care shown by the state to the development of agriculture (poultry farming and quail farming), which is one of the priority sectors of the Azerbaijani economy, is increasing year by year (Gozalov, 2016; Tagiyev, 2013).

This branch of animal husbandry is exceptional in providing the population with the most valuable dietary products (eggs and poultry meat). The main issue in eliminating the backwardness in poultry farming is the specialization of this branch. It should be noted that in no other branch of animal husbandry do we have such extensive opportunities for concentrating production in one place. If the centralization of production in cattle and sheep breeding is due to the creation of a large arable land required to provide animals with various feeds and the difficulty of transporting feeds, then since poultry farming develops mainly at the expense of cereals, the ability to produce any amount of grain is possible for each farm (Wright, 2017; Rakhmanov, 2016).

The White English breed is one of the promising breeds and was brought to our country from Hungary in 1987. The color of the feathers of this quail breed is white, but occasionally black feathers can be found among the feathers. The live weight of females is 190-230 g, and that of males is 170-190 g. Females can lay eggs weighing 10-11 g from the age of 6 weeks and lay 280-310 eggs per year. The live weight of the White English breed females kept in ASAU and in the Ganja-Gazakh zone reaches even 300-310 grams, and that of roosters reaches 270-280 grams (Tagiyev, Adigozalova, Gozalov, 2015; Tagiyev, Zeynalova, Mammadov, 2021).

Conditions, materials and methods of the study. The study was conducted on White English quails raised at the "Quail Breeding Training Center" of ASAU, the "Therapy, Obstetrics and Surgery" department, and on some farms in Goygol and Shamkir regions, as well as on private farms. For the growth of young quails and the protection of the health of old quails, the body must receive regular mineral substances. Mineral substances participate in the metabolic processes in the body and have a great impact on the absorption and assimilation of nutrients. From the research work we conducted, it became clear that the amount of mineral substances in the feed we give to quails is not the same. Therefore, when compiling the feed ration, we controlled the presence of the necessary amount of mineral substances in it.

It has been determined that there are up to 60 mineral substances in the body of agricultural animals. Of these, Ca, P, Na and CI are considered the main ones to ensure normal nutrition. 65-70% of all minerals in the body of quail birds are calcium and phosphorus. These substances are more abundant in milk. Growing young quails have an acute need for calcium and phosphorus. Selection for growth rate has led to the fact that the development of the skeleton in them lags behind the formation of muscle tissue.

The research work showed that at an early age, in young animals, anomalies of the legs are often recorded: chondrodystrophy, dyschondroplasia of the greater tibia, "bowing", rickets. It was determined that in order to ensure maximum growth, high intensity of bone formation processes, and to reduce the number of anomalies of the legs, the levels of calcium and phosphorus in starter diets prepared for young meat quails should be as high as possible, 1.2 - 0.6%.

From our experiments, it became clear that in meeting the needs of White English quails for mineral and biologically active substances, special attention is paid to calcium, since the daily loss with eggshell alone is 2-2.5 g. If we take into account that 50% of the calcium in the feed is absorbed, then quails should receive at least 3.5-5 g of calcium per day. The use of 20 g of calcium from the bone skeleton of quails has a serious impact not only on the fragility of eggs, but also on their productivity and health. In order to achieve maximum absorption of calcium by the body, it is first necessary to regulate the need for vitamin D_3.

During the research work, it was found that phosphorus also plays a major role in increasing egg production. As a rule, quails absorb phosphorus more easily from animal feed than from grass feed. We recommended the use of the enzyme letase to improve the absorption of phosphorus, which is in a complex form in grass feed.

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The need for sodium in white English quails should be monitored more closely. Because an increase in the need for sodium is observed with drought (burn), which increases the humidity of the floor and increases the likelihood of infection with microbes and parasites. As a result of a deficiency, feather shedding and egg hatching may occur.

Balancing the feeds intended for white English quails with regard to the microelements copper, cobalt, iron, iodine, zinc, manganese, selenium prevents various unpleasant situations.

Plant feeds contain less than 5% ash. The stem and leaves of the plant contain 2 times more ash than the grain and root. The amount of ash is higher than that of plants belonging to the legume family than to plants belonging to the cereal family.

In nature, there are 40 types of zeolite used in animal husbandry and poultry farming, and the composition of these zeolites is very similar to each other.

Composition of Aydag mineral $(K_2N_2Ca) \cdot (Al_2Si7O_8) \cdot H_2O$ or depending on the location, it can sometimes take the following forms.

$(Na_2K_2Ca) \cdot (Al_2Si_{10}O_{24}) \cdot 7\ H_2O$

Academician Mirali Qashqay and scientists engaged in mineralogy in Azerbaijan show that there are 250 million tons of Aydag mineral reserves in the areas located near the cities of Nakhchivan and Tovuz.

Light green Aydag from the part near the Jalilli settlement near the city of Tovuz is widely used by us (in 1986-1996). During these periods, the use of Aydag zeolite was patented in the former Soviet Union by Professor A.A. Asgarov, Professor A.A. Tagiyev, Professor H. Mahmudov.

We used 2-5 g of Aydag feed ration given to white English quails, depending on age.

Note: Although Aydag mineral slightly reduces the nutritional value of the mixed feed, it does not affect the productivity of quails, because the digestibility and absorption of nutrients increases due to Aydag. In addition, the food as valuable as Aydag mineral added to the mixed feed is saved.

In order for the feed ration to be richer in macro-micro elements and oxygen compounds, it is important to use marble dust and lime. Chemical composition of marble dust and lime. Marble dust mainly consists of 98.54% calcium carbonate (CaCO3). MgO-0.15%, SiO2-0.45%, F2O3-0.62%, F-0.014%, S-0.005%. The chemical composition of lime is richer. Thus, lime contains oxides, chemical elements, and microelements (table 1) (Tagiyev, Mammadov, 2022).

Table 1. Chemical composition of lime

Chemical elements	Amount
CaO, %	50-52
$CaCO_3$+$MgCO_3$, %	90
Ca, %	34-39
Mg, mg/kg	6000
Si, mg/kg	19000
Fe, mg/kg	2500
K, mg/kg	1200
Al, mg/kg	3300
Na, mg/kg	2200
Mn, mg/kg	200
SO_4, mg/kg	400
P, mg/kg	100

The sample feed contains 1.0% zeolite, a natural mineral feed additive. The general chemical formula of zeolites is $(Na_2K_2, Ca, Ba)\ [(Al, Si)O_2]n \bullet H_2O$ (Tagiyev, Gozalov, 2021; Zeynalova, Mammadov, 2021).

Vitamins are special substances contained in the feed. They are of great importance for the normal functioning of quails. When quails lack vitamins, their metabolism is disrupted and diseases

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occur. When the disease occurs acutely, it is called “avitaminosis”. Avitaminosis usually seriously reduces productivity, hinders the growth and development of quails, and quails with avitaminosis sometimes die.

Several groups of vitamins are known. They are indicated by the Latin letters A, B, C, D, E, K and b. In addition, group B of vitamins includes vitamins B_1, B_2, B_6, B_{12}, and group D includes vitamins D_1, D_2, D_3. Vitamin K is important for normal blood clotting, and when it is lacking, the blood density of quails decreases. Vitamin K is found in the leaves of green plants, silage, grass, leaves of root crops, and grains of beans and cereals. Adding vitamin A to the feed ration increases egg production by 8.14%. Adding vitamin E to the feed ration can improve the quality of quail meat and increase fattening by 2-3%.

Vitamin E also creates favorable conditions for the accumulation of vitamin A reserves in the liver. When vitamin D is deficient, eggs become smaller, their number decreases, and their shells become thinner, resulting in quails suffering from bone cavity disease.

We added yeast, milk waste, fish oil, beetroot, silage, casein, as well as vitamin preparations A-300 mg, D-350 mg, B_2-300 mg, and B_1-200 mg to the feed ration of white English quails (Tagiyev, Zeynalova, 2021).

Conclusion

The results of the study showed that it is possible to increase interest in quail farming in our Republic and increase overall productivity by using White English breeds and using exemplary feed rations with different compositions. The task of the scientific research conducted for this purpose is to study the effect of different (cheap) feed rations in accordance with market demand on the productivity indicators of quails and the quality of the produced product.

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The Main Causes of Pathogenic Diseases in Soil Ecosystems by Microfungi

Abstract

The aim of this study is to investigate the primary causes of pathogenic diseases created by microfungi in soil ecosystems. Microfungi are widespread microscopic organisms in the soil, performing various functions; however, some species possess pathogenic characteristics that can lead to plant diseases. The study explores the activities of microfungi in the soil environment, the impact of ecological factors on these activities, and the spread of pathogenic species of microfungi in the soil. The results show that the pathogenic characteristics of microfungi depend not only on their genetic and morphological structures but also on the physical and chemical conditions of the soil. Ecological factors such as soil pH, temperature, and irrigation practices can enhance the pathogenic features of microfungi. Furthermore, the interactions between microfungi and the soil microbiome, along with their competition with other microorganisms, contribute to the spread of diseases. The research emphasizes the importance of ecological and biological approaches in preventing the diseases caused by microfungi. The application of such methods can help reduce the pathogenic effects of microfungi by increasing soil biological diversity. Consequently, the findings of this research contribute to the development of strategies to combat pathogenic diseases caused by microfungi in soil ecosystems and improve agricultural productivity.

Keywords: *microfungi, pathogenic fungi, soil ecosystems, ecological factors, microbiome, disease spread, soil health, biological diversity, soil pathogens, ecological control*

Introduction

Soil ecosystems are complex microbiological environments that are vital for biodiversity and the food chain. Microscopic organisms living in the soil, including micromycete fungi, play an important role in the protection of the ecosystem and plant health (Aslanova, Asadova, 2023). Micromycete are fungi that have both beneficial and pathogenic functions. Beneficial micromycete increase soil fertility by participating in the decomposition of organic matter in the soil and in the nutrient cycle. However, some micromycete species have pathogenic properties, which can cause plant diseases in the soil. Pathogenic species of micromycete, especially developing in plant roots, damage them, as a result of which plant development is stopped and productivity is reduced (Aslanova, Asadova, 2024).

Research

The diseases caused by micromycete fungi in soil ecosystems threaten not only plant health, but also the ecological balance of the soil. In addition, these diseases can seriously affect agricultural products, water resources and food security. Therefore, the investigation and prevention of the main

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causes of pathogenic diseases caused by micromycete in soil ecosystems is one of the most relevant areas of agricultural and ecological research (Balakhanova, 2024).

Research objective

The main objective of this study is to investigate the role of micromycete fungi in the occurrence of pathogenic diseases in soil ecosystems and to identify the main causes of thesediseases. The activities of micromycete fungi in the soil, their pathogenic potential and the effects of these activities on plant health will be analyzed (Balakhanova, 2022). At the same time, the study also aims to study how micromycete affects soil biodiversity and how changes in the soil environment enhance the pathogenic properties of micromycete.

As a result of fulfilling this objective, the factors that cause the spread of pathogenic species of micromycete in soil ecosystems will be identified and new approaches will be proposed to prevent these diseases (Balakhanova, 2024).

Research object

The object of the research is micromycete fungi and the diseases they cause in soil ecosystems. Micromycete constitute an important part of the soil microflora structure and have a special role for various ecologies (Balakhanova, 2024). However, some micromycete species have pathogenic properties and cause serious diseases in the soil, especially in plant roots. These diseases damage the biological diversity and vegetation of the soil, leading to imbalances in ecosystems (Bakhshaliyeva, Muradov, Ismayilova, Naghiyeva, Mammadova, 2023).

The focus of the research is on micromycete fungi, pathogenic species in the soil and their interaction with plants. In addition, the effect of physical, chemical and biological factors in the soil on the pathogenic potential of micromycete will be studied (Jabrailzade, Aslanova, 2024).

Research methods

A number of methods will be used to conduct this study. These methods were selected with the aim of analyzing the pathogenic activity of micromycete fungi and investigating the main causes of the diseases they cause in soil ecosystems.

Laboratory studies: Experiments will be conducted in laboratory conditions to study the activity of micromycetes in soil and their pathogenic properties. These experiments will analyze how micromycetes develop in different soil environments and conditions and their interactions with plants.

Microbiological analyses: Microbiological analyses will be used to identify pathogenic species of micromycetes in soil samples. These methods will allow us to understand the genetic characteristics of micromycetes and what pathogenic effects they have in the soil.

Analysis of ecological factors: Field studies will be conducted to determine the effects of ecological factors such as soil pH, irrigation regime, and temperature on the pathogenic activity of micromycetes. Experimental conditions will also be created to study how the soil environment affects micromycetes activity under changing conditions.

Genetic and biological analysis: Molecular technologies, especially PCR (Polymerase Chain Reaction) will be used to identify pathogenic species of micromycetes. This will allow us to identify the species of pathogenic micromycetes and accurately measure their impact on soil ecosystems.

Statistical analysis: The data obtained will be analyzed using statistical methods to determine the prevalence and impact of diseases caused by micromycetes in the soil.

Materials and discussion

The materials used in the study will include various soil samples, micromycete fungi, and plant samples. Soil samples will be collected from various ecosystems, agricultural areas, and natural habitats. Micromycete will be selected from various pathogenic and non-pathogenic fungi.

The discussion section of the study will discuss the application of ecological and biological approaches to prevent diseases caused by micromycete fungi in soil. It will also examine how various factors in the soil enhance or reduce the pathogenic effects of micromycete. The results of

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the study will explain the role of micromycete in maintaining ecosystem health and how changes in the soil environment affect the spread of diseases.

Innovation of the research work

The main innovation of this study is the in-depth investigation of the main causes of pathogenic diseases caused by micromycetes in the soil. Previous studies have only studied the general ecological functions of micromycetes, but little attention has been paid to their disease-causing ability. This study will investigate in more depth the pathogenic properties of different species of micromycetes and their impact on plant health. Also, the methods used and the results obtained in this study will provide new biological and ecological information.

Applied significance of the research work

The results of this study will contribute to the development of new methods to control the activities of pathogenic species of micromycetes in the soil and prevent them from causing plant diseases. These approaches can be used in agricultural practices and environmental protection. At the same time, they aim to reduce diseases caused by micromycetes in the soil, maintain the health of ecosystems and improve the quality of agricultural products.

Economic benefit of the research work

Prevention of pathogenic effects of micromycetes will help to increase productivity and reduce diseases in agriculture. The results of this research will allow to prevent plant diseases and increase productivity by applying effective methods of combating micromycetes in soil ecosystems. As a result, increasing the quality and production of agricultural products will be economically efficient and will play an important role in food security issues (Jabrailzade, Aslanova, Ismayilova, 2024).

Conclusion

Micromycete fungi, as an integral part of soil ecosystems, have both beneficial and harmful properties. The results of this study have allowed us to better understand the activities of micromycetes in the soil and their pathogenic properties, thereby providing new approaches to the protection of soil health and the control of diseases encountered in agricultural fields. The main reasons why micromycetes, especially pathogenic species, cause diseases in soil ecosystems have been analyzed (Mathew, Marcel, Nicolas, Priyanga, Jonathan, Martha, Robert, Jonathan, Richard, David, Michel, Andrew, 2004).

As a main result of the study, it was determined that the pathogenic effect of micromycetes in the soil depends on several main factors. Although previous studies have determined the pathogenic properties of micromycetes through genetic and morphological analyses and studied how they spread in the soil, this study examined in more detail how micromycetes respond to changes in the soil environment, changes in ecological factors, and the interaction of microbiomes (Yusifova, Asadova, & Aslanova, 2024). The results showed that the disease-causing potential of micromycetes depends not only on their own properties, but also on the biological and physical conditions of the soil. For example, soil pH, irrigation regime, temperature, and other environmental factors can enhance the pathogenic properties of micromycetes.

In addition, the study showed that the interaction of different species of micromycetes with each other and with other microorganisms in the soil affects the spread of diseases. Micromycetes change the structure of the soil microbiome, creating conditions for the growth of certain pathogens. This leads to the emergence of diseases and crop losses in agricultural areas, as well as negatively affecting the health of the ecosystem (Yusifova, Asadova, Aslanova, 2025).

In addition, it has been found that pathogenic diseases caused by micromycetes in the soil limit the growth and development of plants by preventing their uptake, especially in plant roots. This reduces crop productivity and disrupts the food chain in ecosystems. Such diseases also reduce biodiversity in the soil, as pathogenic micromycetes compete with other beneficial microorganisms and prevent their development. As a result, the balance of soil microbiology is disrupted, making normal cyclical processes in ecosystems difficult.

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Another important result of the study is that it shows that the potential and spread of micromycetes are closely related to environmental conditions and land use. Human activities such as intensive tillage, excessive use of nitrogen and phosphorus fertilizers, and the application of chemical pesticides can enhance the pathogenic properties of micromycetes. Under these conditions, micromycetes spread more widely in contaminated soils, threatening plant health.

One of the main contributions of the study is that it emphasizes the importance of ecologically and biologically based approaches to combat pathogenic diseases caused by micromycetes. The application of more environmentally sustainable methods than traditional chemical control methods is proposed to prevent the pathogenic effects of micromycetes in the soil (Yusifova, Asadova, Aslanova, 2024). The increase in beneficial species of micromycetes and the reduction of their pathogenic species activity by using mycorrhizal relationships can help maintain soil health and increase agricultural productivity. In addition, environmental protection and the application of sustainable agricultural practices are also effective methods to reduce the disease-causing potential of micromycetes.

The results of this study also further clarified the need for the application of integrated management methods and ecosystem-based approaches to combat pathogenic diseases caused by micromycetes in soil ecosystems. For example, it is necessary to create new monitoring systems to monitor micromycetes activity in the soil and detect the potential for pathogen spread at an early stage.

Conclusion

In addition, the study showed that changes in the soil environment, including soil structure and microbiome composition, have a significant impact on the pathogenic potential of micromycetes. This knowledge can help maintain soil health and combat diseases caused by micromycetes. At the same time, these approaches will also promote the development of more sustainable and resilient agricultural systems by increasing soil biodiversity. As a result, soil diseases caused by micromycetes not only reduce agricultural productivity but also disrupt the balance of ecosystems. The development and application of ecological and biologically based control methods are necessary to prevent such diseases. The results of the study show that steps taken in this direction will not only help maintain soil health, but also solve global food security issues. A good understanding of the role of micromycetes in soil ecosystems will also have a positive impact on the protection of ecosystem services, ensuring the sustainability of agriculture.

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Some Genetic and Selection Characteristics of Bozakh Sheep Breed in the Western Region of Azerbaijan

Abstract

Sheep breeding is one of the oldest and most profitable branches of animal husbandry. The state pays special attention and care to the development of sheep breeding in our country. Because, unlike other animals raised in agriculture, sheep have the characteristics of producing more types of products. Sheep produce mutton and dairy products that are well absorbed by the human body. Mutton differs from the meat of other animals in its high calorie content and low cholesterol content in its fat. Sheep wool is considered superior as a raw material source for the wool processing industry and for human health due to its beneficial properties and cannot be replaced by any textile fiber. In Azerbaijan, gene pools of a large number of valuable sheep breeds have been created through folk selection to meet people's needs for food products. Examples of these breeds include: Absheron, Mil-Karabakh, Balbas, Bozakh, Godek, Jaro, Shirvan, Lezgi, Azerbaijan Mountain Merino, Mazek, Garadolag, etc. The article studies some genetic and selection characteristics of Bozax sheep bred in the western region of Azerbaijan. Bozax sheep are bred for meat-milk-wool production. Depending on the direction, the weight and yield of the animal change. These animals are local, distinguished by their high productivity. Currently, in the conditions of a market economy, pedigree Bozakh sheep are also bred in sheep farms and private farms of our country.

Keywords: *sheep, breed, genetics, sheep breeding, selection*

Introduction

Sheep breeding in Azerbaijan has an ancient history. The natural climatic conditions of our country, the presence of large areas of summer and winter pastures are very favorable for the development and further expansion of sheep breeding here. Even in ancient times, the emergence and development of the art of carpet weaving in our country was also associated with sheep breeding. Various types of products are obtained from sheep breeding, which distinguishes it from other livestock breeding areas. In normal pastures with favorable ecological conditions, sheep spend up to 76% of the nutrients of the feed they eat for crop production. Also, in such conditions, every hundred mother sheep can give birth to 100-110 or more lambs. Sheep have a well-developed herd instinct. Therefore, their maintenance and feeding are carried out in large flocks (Abdullayev, Aliyev, 2012; Abbasov, 2011; Zeynalov, 2008; Zeynalov, 2016).

Research

Sheep with high qualities, selected as a result of selection, have retained their valuable genetic traits, disease resistance, breeding ability, and ability to adapt to pasture conditions, despite being exposed to environmental variability due to the influence of various environmental conditions.

Sheep have the ability to adapt well to changing conditions. In this regard, the great potential of sheep to adapt to different conditions of keeping and feeding is their most important feature. Due to their good adaptation to changing conditions, the creation of new sheep breeds by breeders and their breeding in zones with different ecological climates is a positive phenomenon (Podkorytov, 2017; Jensen, 2002).

Today, one of the most promising tasks in the selection and breeding of sheep is to determine the meat and milk productivity of sheep.

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Improving these qualities will allow enriching the gene pool and, as a result, improving the quality of mutton and other sheep products (Jukhoveeva, 2020). Recently, while the range of products made from artificial fibers in light industry has been increasing year by year, sheep breeding is still considered irreplaceable as a source of raw materials for the wool processing industry. Because the best, most beautiful, elegant and high-quality fabrics are made from fine and semi-fine wool. Semi-coarse and coarse wool are used as valuable and high-quality raw materials in the carpet industry (Podkorytov, 2019; Volkov, 2006).

Conducting the research: Sheep products have been widely used as food in our country since ancient times and are still widely used today. The vast majority of national dishes are made from sheep meat, and sheep milk is especially distinguished by the large amount of nutrients it contains. Products made from sheep milk, including Motal cheese, are very popular with our people. In connection with all this, very serious measures are being taken at the state level to further develop sheep farming in Azerbaijan and increase the number of productive sheep breeds. Breeders are working to create new sheep breeds with high genetic characteristics.

Sheep are ruminant animals. They were first domesticated by humans seven thousand years ago. Over time, sheep have been developed in Azerbaijan to meet people's food needs, and through folk selection, gene pools of many valuable sheep breeds have been created. Examples of these breeds include: Absheron, Mil-Karabakh, Bozakh, Godek, Jaro, Shirvan, Lezgi, Azerbaijani mountain merino, Balbas, Mazekh, Garadolag, etc. (Abdullayev, 2012; Zeynalov, 2008; Veniaminov, 1984).

In our country, Bozakh breed sheep are more widespread in the lowland and foothill regions of the western region. These sheep differ from other breeds in that they are both meat, wool, and dairy. Bozakh breed sheep are widespread in Western Azerbaijan and partly in Eastern Georgia. These sheep are considered one of the ancient and local Azerbaijani sheep breeds.

According to the research of Prof. I.I. Kolugin, Bozakh sheep resemble Karabakh sheep in some relative body sizes and appearance. However, they differ from them in the nature and length of their wool. In terms of their appearance, Bozakh sheep are intermediate between Karabakh and Tush sheep and most likely originated from the hybridization of these two breeds.

During the communist era in Azerbaijan, in order to improve the productivity of local meat-wool-milk sheep, Bozakh sheep were crossed with fine-wool rams of other breeds. As a result, the Bozakh breed was brought to the brink of extinction. In the eighties, with the direct participation and initiative of scientific staff of the sheep breeding departments of Azerbaijan Scientific Research Institute of Animal Husbandry and Azerbaijan State Agrarian University, work began on the restoration of Bozakh sheep and improvement of their productivity. In the early nineties, breeding herds of Bozakh sheep were created in the farms of the Tovuz region, a western region of Azerbaijan. This local sheep breed is loved by the people for its high productivity. Currently, in the conditions of a market economy, breeding Bozakh sheep are also bred in sheep farms and private farms of our country.

The most valuable qualities of sheep wool have been known to people since ancient times. Sheep wool is light, elastic, stretchable, durable, has excellent thermal insulation and hygienic properties. It is well dyed and spun, and felt is also made from sheep wool, a property of wool that none of the synthetic fibers have (Weaver).

Although many types of chemical fibers may be superior to wool in certain properties, for example, some in lightness, others in strength, or in beauty and even in price, sheep wool is considered superior to human health in terms of its beneficial properties and cannot be replaced by any textile fiber (Abdullayev, 2012, Podkorytov, 2019).

The wool of the Bozakh sheep is mainly gray, rarely white, brown. Most likely, it was given the name Bozakh sheep, taking into account the grayness of its color.

The Bozakh breed belongs to the coarse-wooled sheep. Its wool is mainly gray (36%), rarely white (12.4%), black-brown (10.1%), yellow and yellow-brown (21.8%). The weight of wool in breeding rams is 6.7-7.3 kg, in ewes 4.8-5.2 kg. It produces an average of 1.8-2.2 kg of wool per year. The length of the wool, which is one of the main quality indicators of wool, varies between 7.6-9.0 cm (Sukhoveeva, 2020).

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Quality indicators of wool in Bozakh breed sheep by gender.
Table 1.

Gender	Fringe length, (cm)	Actual length of wool fiber, (cm)	
		Rustling	Mohair
Male	11,5 - 13,2	12,1-14,6	5, 0 -7,2
Female	10,9-13,6	9, 4 - 11,6	5,1 – 6,9

It should be noted that the quality of the wool also depends on the age, sex, live weight of the animal and the ability of the wool to develop during the corresponding period.

Bozakh sheep are very mobile, medium-sized, well-built animals. Their chest is well developed, and their legs are characterized by strong bones, which is the main feature that distinguishes Bozakh sheep from other breeds. Sheep of this breed are resistant to piroplasmosis and are well adapted to keeping in mountain pasture conditions. They are the only sheep breed in Azerbaijan that has different ear shapes.

Figure 1. Bozakh sheep breeding bred in the western region of Azerbaijan (Azerbaijan Scientific Research Institute of Animal Husbandry).

The live weight of this breed of sheep is usually 50–65 kg. It gives good meat. The live weight of the mother sheep is 45–47 kg, the rams are 55–60 kg, and the meat yield is 50–55%. While the live weight of wool and dairy rams is 52–56.4 kg, this indicator reaches 59.6 kg in the meat-oriented type. Thus, the lowest body weight is recorded in dairy rams, which is equal to an average of 53.7 kg. When examining the live weight indicators of the mother sheep, it becomes clear that while the average indicator for the herd is 40.5 kg in mother sheep, this indicator is equal to an average of 43.8 kg in those of meat-oriented type. The lowest weight is recorded in dairy animals. So, this weight is equal to 37–38 kg.

Mother sheep produce 45-50 kg of marketable milk during lactation. Their lambs weigh 3.3-3.5 kg at birth. They weigh 20-22 kg when they are weaned. The meat yield of these sheep is 50-55%. Due to milk yield, the mother sheep produces 45-50 kg of marketable milk per year. Some productivity indicators of Bozakh breed sheep are given in table 2.

Table 2.
Average productivity indicators of Bozakh sheep.

Productive type	Live weight, kg				Clean wool shearing, (per year) kg			
	Ram, male lamb		Mother sheep, female lamb		Ram, male lamb		Mother sheep, female lamb	
	yaşlı	bir yaşında	yaşlı	bir yaşında	yaşlı	Bir yaşında	yaşlı	Bir yaşında
Wool	56,1±1,26	40,8±1,30	40,2±1,30	35,2±1,33	3,2±1,35	2,5±1,30	2,3±1,28	2,1±1,34
Meat	59,8±1,72	45,9±1,65	43,6±1,58	37,6±1,32	2,8±1,58	2,1±1,32	2,1±1,31	1,8±1,27
Dairy	52,6±1,32	38,2±1,30	38,2±1,35	33,2±1,27	2,2±1,43	1,7±1,29	1,8±1,45	1,7±1,35

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Sheep milk differs significantly from cow's milk in terms of its chemical composition and nutritional value, as sheep milk contains 1.5 times more dry matter, 1.7 times fat, and 1.6 times more protein. Milk from mountain sheep contains 17-20% dry matter, 5.5-7.0% fat, and 5.7-6.0% total protein, and the energy value of one kg of such milk is 1218 kcal.

Although Azerbaijani mountain menino sheep are meat and wool-producing, the milk yield of the mother sheep during lactation is 45-50 kg. Its milk is known for its normal nutrition of lambs until weaning and its high fat content.

Conclusion

The Bozakh breed is fully adapted to living in the natural geographical and climatic conditions of the Ganja-Gazakh region of our republic (mainly in the mountain and foothill zones). They make good use of mountain and foothill pastures. These sheep have very sharp, pointed teeth and thin, mobile lips, which allows the sheep to skillfully use pastures with very low or coarse cover. Sheep of this breed make good use of the feed available in pasture conditions throughout the year. This directly affects the low cost of the product obtained from them. In natural conditions, Bozakh sheep use various types of grass, including weeds, throughout the year. The multi-chambered stomach of the sheep and the well-developed digestive system ensure the full use of nutrients contained in the feed. At the same time, these sheep have a very tolerant temperament.

Since 2025, Azerbaijan Scientific Research Institute of Animal Husbandry has been conducting modern selection work and creating new sheep breeds, and work is being done to obtain new lines and breeds by crossing sheep imported from foreign countries with local Bozakh breed rams. The goal of this work is to create a more productive, disease-resistant sheep breed with good genetic characteristics. In addition, work is being done to improve local sheep breeds and types, restore and protect sheep breeds created through folk selection, as well as those in danger of extinction. Proper use of the potential of sheep is of great importance in sheep breeding.

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Calculation of the Kinetic Parameters of the Modification Reaction of Polyisobutylene With Acrylonitrile

Abstract

In the article, the results of the research on the calculation of the mathematical model and parameters of the copolymer production process by modifying polyisobutylene with acrylonitrile polar monomer at a temperature of 20-60^{0}C in the presence of $AlCl_3$ catalyst have been reflected. Using this, the results of the study of the effect of polyisobutylene with acrylonitrile on the reaction conditions have been given, the kinetic equations of those reactions have been calculated, the values of the parameters, the analysis of the researches in the field of mathematical modeling of the process were reflected. This method allows us to reduce the number of experiments, resources and time, and also to obtain an arbitrary ratio of acrylonitrile to polyisobutylene that satisfies us within the limits of experimental parameters. The functional dependence between those parameters has been drawn up by analyzing the regularities of the ratio of the solidities of [AN] and [PIB] in the copolymer on temperature, reaction time, and the solidities of PIB, AN and the catalyst ($AlCl_3$) in the initial solution. The kinetic parameters of the PIB modification reaction with AN have been calculated on the basis of the developed kinetic model and experimental materials. The rate constants of the reactions corresponding to the temperatures of 20, 40, 60^{0}C for 1.8% (mass)

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catalyst amount are 0.7699; 0.8322 and 0.89 s^{-1} have been obtained. The rate constants corresponding to those temperatures and 0.92% amount of catalyst were 0.2976, 0.3288, 0.3581s^{-1}. The effect of the amount of catalyst on the activation energy has also been studied; E=3000 C/mol. (AlCl3=1.8%) (mass) and E=3750 C/mol. (AlCl3=0.92%).

Keywords: *Polyisobutylene, acrylonitrile, polar polymer, $AlCl_3$ catalyst, copolymer, temperature*

Introduction

In general, there is no clear boundary between empirical and kinetic modeling methods. The study of the kinetic mechanism in detail can be more or less in-depth depending on the conditions imposed. In one case, the set low speeds will have a significant effect on the operation, and in the other case, they may have little effect on the progress of the synthesis. In addition, the detailed kinetic explanation of the process, some parts of the elementary stages can be replaced by gross rates. Gross-kinetic can fully characterize the process along with a good structure explanation and can be considered useful for process intensification and optimization. An example of this is the mathematical explanation of the thermally excited radical polymerization process of styrene in bulk. However, the given explanation can be obtained on the basis of an accurate study of the chemistry and physics of the process. Therefore, there is an imprecise boundary between empirical and fundamental explanations of the process, and it is determined not by the form of the problem, but in the first case by a formal mathematical method, and in the second case by physical and chemical studies of the process (Agakishiyeva, Aliyeva, 2007; Kondaurov, 2005).

Research

Methods of calculating chemical reactors in cases where the reaction mechanism and kinetic constants are known, have been given in the literature. However, during the fundamental research of chemical processes, it is usually necessary to solve opposite problems. In cases where it is possible to experimentally measure the concentration of substances, it is possible to restore the kinetic constants if the mechanism of the reaction is known. This issue is complicated because in this case it is also necessary to solve the straight issue (Azizov, Alosmanov, Akberov, 2004).

The reverse problem of restoring the kinetic mechanism is simple. This is the issue

It becomes simpler if several more hypothetical mechanisms are taken and one of them is selected. The problem is solved by calculating all the options and finding the option that pays the experimental indicators more accurately. If the number of experiments is not enough, it is important to add additional experiments (Berengarten, Bondareva, Kutepov, 2007).

If the rate constants of only a few elementary stages are unknown, then the problem is devoted to finding those constants. Let's assume that the following are given: Kinetic mechanism (perhaps the values of several constants are also given); Process conditions (temperature, pressure, etc.); Time dependence of the concentration of some substances (or kinetic curves).

For polymer problems, some properties of molecular distributions must also be known. Let us denote them by $A_{ig}(t)$ $i = 1,....,n.$ The objective function $f(k_1,...k_m)$ is taken. Here $k_1,\ldots,k_m$ are unknown constants. The following function should be minimized.

$$F(k_{1....,}k_m) = \sum_{i=1}^{n} \sum_{\gamma=1}^{m} \left[A_{iP}(t_\gamma) - A_{ig}(t_\gamma)\right]^2$$ where $t_{1,}$ ....., t_m - the times when the densities of Aig are measured; $A_{ir}(t)$ - kinetic curves calculated for the case where the constants $k_{1,}\ldots, k_m$ are given..

Mathematical methods for minimizing multiple unknown functions are divided into two groups: gradient and Monte Carlo random search methods (General course of processes and apparatuses of chemical technology, 2002; Savelyanov, 2007). During the development and optimization of new technological processes of polymer synthesis, the analysis of the kinetic model of the process is the basis for calculating the operating mode of the reactor. The kinetic model describes the speed of the reaction and the structure of the formed polymer in time and space. Changes in time and space occur due to the influence of temperature, pressure, concentration of reagents and other factors.

One of the most difficult points in this field is the development of a kinetic model. The model should adequately describe the experimental data over a wide range of conditions.

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Until recent years, the kinetic method of analysis has been used as a laboratory method to determine the chemical mechanism of a reaction, which, depending on the problem, usually separated any stage of the reaction. The choice of experimental conditions has been also determined by the problem at hand. Usually, the kinetic region of the reaction process was considered in the periodic regime of the synthesis in concentrated solutions (Bilalov, Huseynov, Abbasova, 2002; Hajiahmedzadeh, 2017).

The analysis of industrial processes by the kinetic method and their research began in the last decades. At the present stage, the high quality of the product, the demand for the creation of units with great power, the development of computing techniques and the development of the methods of analysis of the structure of products have been the stimulus for the solution of the mentioned issues.

The rate of the reaction, the average molecular masses and the ratio of the first cycles of the distribution according to the molecular masses are considered as the object of the calculation of the kinetic schemes of the polymerization processes. In general, other parameters of the molecular structure can be taken into account, for example, composition, compositional inhomogeneity for copolymers, etc (Smirnov, Volzhinsky, 1977; Yusubov, 2015).

A joint consideration of the values of the parameters of the reaction rate, the convection of monomers and the structure of the polymer allows to solve the problem of choosing the optimal configuration of the reactor and the optimal mode of synthesis. It is convenient to divide the parameters that determine the progress of the process into two groups: discrete parameters and continuously variable parameters. Discrete parameters determine the phase state of the reagents, the mechanism of the reaction (including the method of adjusting the molecular weight and the type of initiator). Continuously variable parameters determine the concentration of reagents, temperature, pressure, linear velocity of the flow, linear dimensions and volume of the reactor.

A common approach to optimization is to select the second set of parameters while keeping the first set of parameters fixed. The limits of the second group are generally determined by the thermodynamics of the process for the limit values of density, temperature, pressure, possibility of additional reactions and technical considerations. But even in this case, it is not possible to select and cover all values of the parameters. Three methods of approaching the solution of the mentioned problem are shown: 1. Solving the problem by "Random search", that is, by the method of arbitrary combination of the first and second group parameters. The construction of that combination is based on the experience and intuition of the researcher; 2. Selection of values of parameters determined with the help of various efficiency criteria and changed in a certain field; 3. Special mathematical methods of searching for the extremum (for example, dynamic programming method, variation method, Box-Williams method, etc.) are the first approach in the technology up to now.

Technologists are more inclined to the "black box" approach to optimization. In this case, the internal relations of the object are not studied, but the changes in the output caused by the change of the input parameters are fixed. Obtaining the results accordingly allows you to get the most general picture of the mathematical model (in the form of a matrix of polymers). Such a regression model differs from a kinetic model in that it does not clearly provide information about the physical and chemical mechanism of the process. Such a model is effective in automatic process control or modeling processes that require a lot of difficult calculations in a theoretical approach (Ablonin, 2001; Kahramanov, Kasumova, Osipchik, 2017).

It should be noted here that regression models lag behind kinetic models in terms of accuracy when extrapolating results beyond the range of parameters.

Experimental part: During the modeling and optimal design of the polymerization process, the kinetic model is preferred because the extrapolation of the results is an important issue considering all the parameters.

Concrete issues in the field of optimization of polymerization processes can be conventionally divided into two groups: 1) development of new technological processes; 2) improvement of industrial facilities.

The difference here is that the restrictions imposed on the first and second groups are different. In the second case, it is more difficult to solve the problem, because a lot of capital investment is allocated to their reconstruction, and in addition, various technical issues arise.

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PIB modification reaction with acrylonitrile at temperature 5–60^{0}C, catalyst ($AlCl_3$) concentrations 0.92 ÷ 1.8%(mass), reaction time 0.0833 ÷ 1.5 hours, initial $[AN]_0$ in initial solution 4 ÷ 32% (mass) concentrations and the initial concentration of $[PIB]_0$ in the initial solution was 6.12% (wt.) (Jantas, Draczynski, Herezynska, Stawski, 2012; Salimova, Shahpelangova, 2009).

The main goal of the research described in this section is to develop a kinetic model of the reaction of modification of PIB with acrylonitrile, and to calculate kinetic parameters based on it and using experimental data.

Some of the experimental materials of the kinetic studies of the reaction of PIB modification with acrylonitrile are given in Tables 1 and 2.

$AlCl_3$ has been used as a catalyst and hexane as a solvent for all versions of the reaction.

For the calculation of kinetic parameters, the reactions have been carried out at temperatures of 20, 40, 60^{0}C. Kinetic parameters have been determined to be recorded at the initial fixed time 5 minutes after the start of the reaction. The equilibrium time of the reaction was 90 minutes (Mirzai, Ibragimov, Gashimov, Yusubov, 2008; Naibova, 2014).

For each temperature, the reaction product copolymer was analyzed 5, 10, 20, 30 and 90 minutes after the start of the reaction. Experimental data obtained under the same conditions for all three temperatures have been used, that is, the same initial amount of AN and PIB, the reaction product analysis times, the same amount of catalyst and solvent have been taken.

In order to clarify the influence of the amount of catalyst on kinetic parameters, calculations have been made in two variants: 1) the amount of catalyst is 1.8% (by mass) of the initial mixture (tab.1); 2) the amount of the catalyst is 0.92% (by mass) of the initial mixture. The amount of solvent corresponding to them is determined. The rest of the conditions remain unchanged and are taken the same.

As can be seen from Table 1, the largest destruction percentage of PIB is 11.5% (mol) relative to its initial value (calculations are obtained from the ratio $[AN]c/[PIB]_0 \cdot 100\%$ (mol)). This indicator has a temperature of 60^{0}C and a reaction time of 1.5 hours. 0.576 g (1.8%) of the catalyst has been obtained. In this case, acrylonitrile is used up to 2.1% of its initial amount.

Table 1.

Kinetic parameters of PIB modification reaction with acrylonitrile: catalyst – amount of $AlCl_3$ 0.576g (up to 1.8% of the mass of the mixture), amount of solvent hexane 24.932 (77.91%); $[AN]_0$ = 0.14g/g; $[PIB]_0$=0.062 g/g; the amount of mixture in the reactor is 32g.

Temperature, ^{0}C	Time, hour	$[AN]_c$, q/q	k, hour^{-1}
20	0	0	–
– " –	0.0833	0.0005344	0.7706
– " –	0.1667	0.001078	0.7448
– " –	0.333	0.002191	0.7747
– " –	0.5	0.003344	0.7895
– ″ –	1.5	0.003937	0.3197
40	0	0	–
– " –	0.0833	0.0005812	0.7855
– " –	0.1667	0.001178	0.8158
– " –	0.333	0.002400	0.8542
– " –	0.5	0.003656	0.8734
– ″ –	1.5	0.004344	0.3473
60	0	0	–
– " –	0.0833	0.0006094	0.8607
– " –	0.1667	0.001228	0.8790
– " –	0.333	0.002503	0.8909
– " –	0.5	0.003825	0.9294
– ″ –	1.5	0.004537	0.3707

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It can be seen from Table 2 that by reducing the amount of catalyst from 0.576 g (1.8%) to 0.295 g (0.92%), PIB is destroyed up to 7.34% (mol). In this case, the consumption of AN is only 1.35% (other parameters do not change) (Smirnov, Volzhinsky, 1977).

Let's make a kinetic model of PIB modification reaction with acrylonitrile. Consider that the density of acrylonitrile in the reaction system at time t=0 was $[AN]_0$ g/g, and the density of polyisobutylene was $[PIB]_0$ g/g.

Acrylonitrile in the amount of [AN]c g/g and polyisobutylene in the amount of [PIB]c g/g react during the time t. In this case, unreacted acrylonitrile remains in the system in the amount of $[AN]_0$ - [AN]c and polyisobutylene $[PIB]_0$ - [PIB]c. Then the rate of PIB modification reaction with acrylonitrile can be expressed by the following equation (Beskov, 2005):

Table 2.

Kinetic indicators of the reaction of PIB modification with acrylonitrile: the amount of catalyst - AlCl3 is 0.295 g (1.8% of the mixture), the amount of solvent - hexane is 25.241 (78.88%); $[AN]_0$ = 0.41g/g; $[PIB]_0$=0.062 g/g; the amount of mixture in the reactor is only 32g.

Temperature, ^{0}C	Time, hour	$[AN]_c$, q/q	k, hour^{-1}
20	0	0	–
– " –	0.0833	0.0002062	0.3021
– " –	0.1667	0.0004156	0.3027
– " –	0.333	0.0008344	0.2983
– " –	0.5	0.001259	0.2873
– ″ –	1.5	0.001884	0.1478
40	0	0	–
– " –	0.0833	0.0002312	0.3520
– " –	0.1667	0.0004625	0.2976
– " –	0.333	0.0009344	0.3336
– " –	0.5	0.001412	0.3322
– ″ –	1.5	0.002131	0.1696
60	0	0	–
– " –	0.0833	0.0002469	0.4018
– " –	0.1667	0.0004937	0.3351
– " –	0.333	0.0009937	0.3437
– " –	0.5	0.001503	0.3518
– ″ –	1.5	0.002309	0.1829

$$-\frac{d([AN]_0-[AN]_c)}{dt}=k([AN]_0-[AN]_c)([PIB]_0-[PIB]_c) \quad (1)$$

It is obvious that the equation (2) can be written as follows:

$$\frac{d[AN]_c}{dt}=k([AN]_0-[AN]_c)([PIB]_0-[AN]_c) \quad (2)$$

Here $[AN]_0$, g/g – the initial amount of AN in the reaction mixture; $[PIP]_0$, g/g – amount of PIP in the initial mixture; k, hour-1 – rate constant of PIB modification reaction; [AN]c, w/w – the amount of AN in the resulting copolymer; [PIP]c, w/w – the amount of PIP in the copolymer (Timofeev, Serafimov, Timoshenko, 2010).

Taking into account the initial conditions, the integral of (3) gives the following expression:

$$k=\frac{1}{t}\cdot\frac{1}{[AN]_0-[PIB]_0}\ln\frac{[PIB]_0([AN]_0-[AN]_c)}{[AN]_0([PIB]_0-[AN]_c)} \quad (3)$$

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Indicators for calculating k have been taken from tables 1. and 2.

The values of k for each fixed reaction time and temperatures of 20, 40, 60^0C are given in tables 1. and 2.

Let's determine the activation energy E and the exponential front stress A based on the Arrhenius equation – $\bar{k}$ =Aexp[-E/(RT)] using the indicators of obtained for three temperatures. It is obvious that

$$\ln \bar{k} = \ln A - \frac{1}{RT} \cdot E$$

According to the conditions of the reaction that we are looking at, the parameters of the Arrhenius equation are as follows: $\bar{k}$, hour^{-1}; A, hour^{-1}, E,C/mol; R, C·mol^{-1}·K^{-1}; T,K.

If we replace the values of and universal gas constant R= 8.3143 C·mol^{-1}·K^{-1} in the Arrhenius equation by performing calculations by the least squares method from tables 1. and 2. 3. we get the indicators in the table.

As can be seen from table 3, activity energy does not receive a large price. This shows that the reaction of modification of PIB with acrylonitrile takes place easily in the temperature range of 20-60^0C and under the conditions of the catalytic process (Yusubov, 2015). Thus, based on the research, we come to the conclusion that the values of the kinetic parameters of the reaction of modification of PIB with acrylonitrile are suitable for the course of the process.

Table 3.

Results of calculation of activation energy and exponential forward stresses.

T, K	$\bar{k}$, saat^{-1}	$\ln \bar{k}$	*R*,C mol^{-1} K^{-1}	$\frac{1}{RT}$, C^1·mol^{-1}	*A*, saat^{-1}	*E*, C/mol
$AlCl_3$ =1.8 %						
293	0.7699	– 0.2615	8.3143	$4.105 \cdot 10^{-4}$	2.63	3000
313	0.8322	–0.1837	8.3143	$3.843 \cdot 10^{-4}$	2.63	3000
333	0.89	$\bar{0.1165}$	8.3143	$3.612 \cdot 10^{-4}$	2.63	3000
$AlCl_3$ =0.92 %						
293	0.2976	–1.212	8. 3143	$4.105 \cdot 10^{-4}$	1.3935	3760
313	0.3288	–1.112	8.3143	$3.843 \cdot 10^{-4}$	1.3935	3760
333	0.3581	–1.027	8.3143	$3.612 \cdot 10^{-4}$	1.3935	3760

Activity energy values – E= 3000 C/mol ($AlCl_3$=1.8% (mass)) and E= 3760 C/mol ($AlCl_3$=0.92% (mass)) is satisfactory.

Conclusion

The average value of k for the temperature of 20^0C has been calculated $\bar{k}_{20}$ =0.7699 h $^{-1}$. In this case, the k found for the equilibrium state of the reaction after 1.5 hours has not been taken into account, because during this period k, which reflects the rate of the reaction, drops sharply. At a temperature of 20^0C, the deviation (difference) of the values of the rate constants obtained for different times from their average value is on average ±3%.

Average values of k for temperatures of 40^0 and 60^0C are: $\bar{k}_{40}$ =0.8322 h^{-1}, $\bar{k}_{60}$ =0.89 h^{-1}. The average error of the deviation of the rate constants from the mean value was ±3 and ±4% for temperatures of 40^0 and 60^0C , respectively. As can be seen from table 1, as the temperature increases, the value of the rate constant of the reaction increases, which is a legitimate case.

Using the indicators of table 2, the rate constant of the reaction was determined for the case of 0.92% penetration of the catalyst (that is, 2 times less than in table 1). Here, the average value of the rate

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constant of the reaction of modification of PIB with AN is =0.2976 according to the temperatures of 20, 40, 60^0 C; $\bar{k}_{20}$ = 0.2976; $\bar{k}_{40}$ = 0.3288; $\bar{k}_{60}$ =0.3581 h^{-1} has been obtained.

The deviation of the values of speed constants obtained for different times from the average value is on average ±2÷3%. We accept this as normal, because this value is within the margin of error of experiments.

At different catalyst prices and other factors being held constant, comparison of the average values of the obtained rate constants leads to the conclusion that the amount of the catalyst has a significant effect on the reaction rate. For example, increasing the amount of the catalyst from 0.92% to 1.8% of the mixture increases the reaction rate by 2.5 at temperatures of 20, 40 and 60^0C, respectively; 2.53; causes an increase of 2.49 times

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Combined anti-Mastitis Composition

Abstract

For the first time, studies were conducted to learn the therapeutic efficacy of tissue-drug therapy using a tissue preparation and a mixture of naphthalene oil, olive oil, camphor oil, analgin and streptocide powder. The traditional method of antibiotic therapy was used as a comparison. Comparing the results of the therapeutic efficacy of the administered drugs showed that the method of tissue-drug therapy is more effective, since when using antibacterial drugs, milk obtained from dairy cows is allowed to be used for food purposes only four days after the last case of drug use, and slaughter of cattle for meat after seven days, and when treating the method we proposed, using a tissue preparation with a cutaneous method of applying a mixture of naphthalene oil, olive oil, camphor oil, analgin and streptocide powder to the udder area, milk obtained from dairy cows is allowed to be used for food purposes immediately after recovery.

Keywords: *Tissue preparations, naphthalene oil, camphor oil, analgin, streptocide, udder lobes, mastitis, antibiotics, streptococci*

Introduction

According to the European Association of Animal Breeders and numerous studies, clinical mastitis is detected in 25% and subclinical mastitis in 50% of dairy cows.

Intensive research is underway to develop and implement safe and highly effective treatments for bovine mastitis.

The etiological factor contributing to the development of mastitis in animals is pathogenic and conditionally pathogenic microflora. Antibiotic-resistant strains are emerging among the isolated strains.

Therefore, there is an urgent need to develop a method for treating mastitis caused by antibiotic-resistant bacterial species.

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Despite antibiotics being the primary therapeutic agents for mastitis treatment, they are associated with serious problems. Thus, to improve the effectiveness of mastitis treatment, there is an urgent need for a new, effective, alternative therapeutic agent.

Research

Tissue biopreparations are increasingly used in the pathology of many infectious diseases, including mastitis (Bodiev, 1983; Pasechnikova, 2007). These preparations have a therapeutic effect in diseases that are difficult to treat with traditional methods. Tissue therapy can also be combined with the use of antibacterial drugs (Voitenko, Kartushina, Pushkareva, Bondareva, 2014).

Tissue therapy stimulates and normalizes various functions of the animal's body, improves the trophic function of the nervous system, increases the function of the thyroid tissue, adrenal glands, pancreas, increases the formation of adrenocorticotropic hormone, the release of corticosteroids, the secretory and motor function of the gastrointestinal tract, gas, intermediate and phosphorus metabolism, and regenerative processes (Vasiliev, 2008; Voitenko, Kartushina, Pushkareva, Bondareva, 2014).

Tissue preparations, unlike antibiotics, lack antimicrobial activity, but their bioactive substances influence metabolic processes in the animal's body, reducing or even stopping inflammation at the site (Sotnikova, 2006; Vasiliev, 2008).

Given the above, the aim was to study tissue-drug therapy to complement and enhance the therapeutic effect.

Materials and methods. The study was conducted at a private farm of Veli Kuliev, Kararkh village, Samukh district, and the regional laboratory. Monitoring the health of the animals, a dispensary examination was performed. The examination revealed several cows with signs of mastitis.

Milk from diseased cows was aseptically collected from udder quarters for bacteriological examination. Teats were treated with 70% alcohol before sampling. Milk samples from each cow were collected in numbered tubes, corresponding to the cow's number. The milk samples were examined in the zonal bacteriological laboratory (Belkin, Cherepakhina, Popkova, Skrebneva, 2010).

First, a reductase test was performed. Six tubes, numbered for each cow, were placed in a rack. 20 ml of milk sample and 1 ml of methylene blue were added to each tube. The mixture was incubated at 37°C. Decolorization time of methylene blue was determined at 20 minutes, after 20 minutes, and after 2 hours. Data are presented in Table 1.

Methylene blue decolorization rate.	Test tube 1	Test tube 2	Test tube 3	Test tube 4	Test tube 5	Test tube 6	Quality assessment of milk
Up to 20 minutes.	+	+	+				very bad.
After 20 minutes to 2 hours.				+	+	+	bad.
Two hours or more.							Satisfactory

As shown in table 1, the first three of six milk samples discolored methylene blue faster, indicating very poor quality. In the remaining tubes, discoloration occurred after 20 minutes, indicating poor quality. This confirmed high bacterial contamination.

Cultures were also performed on solid and liquid nutrient media to investigate for staphylococci, streptococci, and enterococci. Colony morphology was studied on meat-peptone agar. The presence of E. coli and Salmonella was determined on Endo agar, and their differentiation was performed.

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Gas production was tested on Kessler medium. Anaerobes were tested on Kitt-Tarozzi and Wilson-Blair media. After incubation, smears were prepared from colonies grown on nutrient media, Gram-stained, and examined under a microscope. Gram-positive cocci, arranged in pairs or short chains, were identified. Blood agar was used to study the hemolytic properties of the isolated strains, and Kartashova's selective media (liquid and solid) and Edwards medium were used to identify streptococci (Bozhenov, 2007).

Small, dewdrop-like colonies with a zone of hemolysis were observed on blood agar. In Kartashov's broth, the medium changed from blue to green, indicating the presence of streptococci, which ferment lactose, turning the medium green. On Kartashov's agar, small, transparent colonies grew against a blue background, with the surrounding medium turning green. On Edward's medium, streptococci grew as small, grayish-blue colonies. The isolated streptococci were identified using group diagnostic serum in an agglutination reaction. Str. agalactiae and Str. dysagalactiae were identified (Danilevskaya, 2010).

For a tissue preparation from freshly slaughtered cattle under strictly aseptic conditions, parenchymal organs (spleen, liver, and adrenal gland) were taken in the following weight ratio: 89% spleen, 10% liver, and 1% adrenal gland.

After thorough defatting, the spleen, liver, and adrenal gland were refrigerated at 4°C for 6 days. Following this, the organs were minced, and the resulting mince was diluted with isotonic solution at a ratio of 1:2. The mixture was extracted for 2 hours at room temperature with constant stirring. The suspension was then boiled for 1.5 hours and cooled for 3 hours at room temperature. The resulting mass was squeezed through a dense cloth, and the expressed liquid was centrifuged. The supernatant was poured into sterile vials and autoclaved for 1 hour at 1.5 atm. Bacteriological tests were performed to check for sterility (Daricheva, 2000).

Research findings. Clinical examination revealed tenderness, fever, and hyperemia in specific udder areas of 8 cows. Animals showed poor appetite and low milk yield.

For therapeutic purposes, animals were divided into two groups of four animals each. Group 1 animals received a biostimulator subcutaneously in the middle third of the neck at a dose of 1 ml per 10 kg of body weight, and the udder was treated with a mixture of 100 g of naphthalan oil, 100 g of olive oil, 20 g of camphor oil, 10 g of analgin, and 20 g of streptocide powder. Group 2 animals received an intramuscular injection of a penicillin and streptomycin mixture at a dose of 1g/20kg of body weight for therapeutic purposes. Treatment regimen (Polyantsev, 1982).

Daily monitoring of the cows was implemented. Recovery was assessed by changes in general condition, body temperature, swelling, tenderness, and mammary gland secretion.

Key indicators of therapeutic efficacy were reduced disease duration, the dynamics of the disappearance of main clinical symptoms (general condition, temperature response, tenderness of the affected area, etc.), and treatment costs. The rate of decline in main clinical symptoms was assessed starting from the 3rd day after drug administration (Gorbatova, Gunkova, 2009).

Group 1 animals, by day 3 of treatment, showed restored appetite, local temperature, and milk yield.

Group 2 animals, by day 3 of treatment, showed restored appetite, a slight decrease in local udder temperature, and pain responses upon udder palpation.

Experienced animal group	Biostimulant and a mixture of naphthalan oil, camphor oil, analgin, and streptocide powder for topical use.	Penicillin and streptomycin mixture
Group 1.	Subcutaneous biostimulant 1 ml / 10 kg body weight, and the drug mixture applied topically 3 times daily after milking.	
Group 2.		Once daily, 1g/20kg body weight. Intramuscularly

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On day 7 of the treatment course, the overall condition of the animals in the first group improved, appetite returned, udder temperature normalized, and hyperemia disappeared. Animals in the second group also showed improvement, with the temperature of the affected area gradually decreasing. Milk samples were collected from each group for a repeat reductase test (Gorlov, Yurina, Slozhenkina, 2008).

Results of the reductase test are shown in table 3. Methylene blue decolorization rate.	Test tube 1	Test tube 2	Test tube 3	Test tube 4	Test tube 5	Test tube 6	Quality assessment of milk
Up to 20 minutes.							Very bad.
After 20 minutes to 2 hours.							bad.
Two hours or more.	+	+	+	+	+	+	Satisfactory
5 ½ hours and more.							Good.

As shown in Table 3, the decolorization of methylene blue occurred after 2 hours of incubation in a thermostat with a mixture of milk and methylene blue. The bacterial content in the milk, as well as their enzymes, was low, and the milk sample quality is considered satisfactory. Comparing the results of the reductase test before and after treatment, it can be noted that before treatment, the reductase test for three samples was rated as "very poor," and for the rest as "poor," but after treatment, these indicators were low and rated as "satisfactory" (Krus, Shalygina, Volokitina, 2002).

Conclusion

Treatment methods in all animal groups had the same effect on the body of cows with mastitis. However, comparing the therapeutic efficacy of the administered drugs showed that tissue-drug therapy is more effective. When using antibacterial drugs, milk from dairy cows can be used for food purposes only four days after the last administration of the drug, and slaughter of cattle for meat is allowed after seven days. In contrast, with our proposed method, using a tissue preparation with a topical application of a mixture of naphthalan oil, olive oil, camphor oil, analgin, and streptocide powder to the udder area, milk from dairy cows can be used for food purposes immediately after recovery.

Therefore, our recommended cloth-drug therapy is safe and can be widely used in livestock farms for treating mastitis in cows.

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UV-Visible Spectroscopy and XRD Analysis of Ag Nanoparticles Obtained from *Artemisia Lerchiana* W. Plant Extract

Abstract

The increasing global focus on green nanotechnology research has spurred the development of environmentally and biologically safe applications for various nanomaterials. Nanotechnology involves crafting diverse nanoparticles in terms of shapes and sizes, with a particular emphasis on environmentally friendly synthesis routes. Among these, biogenic approaches, including plant-based synthesis, are favored for their safety, simplicity, and sustainability. Silver nanoparticles, in particular, have garnered significant attention due to their exceptional effectiveness, biocompatibility, and eco-friendliness. *Artemisia Lerchiana* has emerged as a promising candidate for aiding in the green synthesis of silver nanoparticles. Leveraging the phytochemical constituents of *Artemisia Lerchiana*, researchers have successfully tailored silver nanoparticles for a wide array of applications, spanning from biomedicine to environmental remediation. This review explores the properties, synthesis mechanisms, and applications of silver nanoparticles obtained from *Artemisia Lerchiana*. Additionally, it delves into the recent advancements in green synthesis techniques and elucidates the optical properties of these nanoparticles. The structures of the synthesized silver nanoparticles were elucidated by UV-Vis and XRD analyses.

Keywords: *Green synthesis, Ag nanoparticles, Artemisia Lerchiana W., UV-visible spectroscopy, XRD*

Introduction

Nanotechnology aims to create new structures in nanoscale size (0.1–100 nm in diameter) by controlling substances at the atomic and molecular levels. Nanotechnology, which has contributed greatly to developments in medicine, technology, and engineering, has been popular in recent years (Huang H. et al., 2004; Geetha K. et al., 2013). In addition, nanotechnology creates a multidisciplinary working system in areas such as food, agriculture, medicine, and textile together with biotechnology. Nanoparticles can be obtained using different metals (silver, copper, titanium, etc.), among them, silver nanoparticles are preferred because they are natural and not harmful to human health as well as they are used in biomedicals (Zafar et al., 2019; Genc N. et al., 2021). Silver is a noble metal with a long history of use in different forms and for various purposes and has long been known for its beneficial properties acting in wound healing and infections, among others (Alexander, 2009). In comparison to chemical and physical methods, biosynthesis processes are quick, easy, cheap, and, most importantly, efficient and environmentally friendly (Kadhim et al., 2022) In practice, the extract's constituents act as potential capping and reducing agents, limit the over-growth of nanoparticles in colloidal synthesis and prevent their excessive accumulation. These molecules could also affect and improve the characteristics of the resulting nanoparticles by enhancing the performance of these molecules to make them more suitable for a variety of applications (Mohamad et al., 2014). Biogenic synthesis of nanoparticles, particularly plant-based nanoparticle synthesis, appears to be a more efficient process because it does not use risky or dangerous chemicals, as utilized in organic synthesis, to generate nanoparticles (Bar et al., 2009). Silver nanoparticles (AgNPs) stand out due to their intrinsic properties such as high stability, strong absorption in the visible ultraviolet region, and broad potential for applications, which are made possible by the significant surface/volume ratio that gives nanoscale particles different attributes to

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those on a larger scale. In turn, the shape, size, distribution, and surface-related aspects of AgNPs are determined by the concentrations of reducing agents, metal precursors, and stabilizers used during synthesis (Ali et al., 2022; Parmar et al., 2022).

Research

Materials

2.1 Preparation of wormwood extract and silver nitrate ($AgNO_3$) solution

In order to get the plant extract have been used the vegetative organs of *Artemisia lerchiana* Web. Plant samples were collected from Lokbatan settlement of Absheron region of Azerbaijan in the summer season (fig 1). The samples were washed several times first with tap water and then with distilled water. The leaves of plant samples were dried in room conditions for 48 hours. 50 g of dried plant leaves were placed in a 500 ml beaker, then 250 ml of distilled water was added, and the mixture was boiled. The mixture is boiled for 5 minutes to get the desired result. Then the extract was cooled to room temperature. Filtering of the plant extract was done with No. 1 Whatman filter paper. The obtained extract was stored at +4 °C until experiments. In order to obtain silver NPs, a solution of silver nitrate was prepared in the following proportion: 25 grams of salt were dissolved in 300 ml of distilled water.

A B

Figure 1. Map representing the site from where the samples of *Artemisia Lerchiana* were collected. (A) Map of Absheron, (B) location of Lokbatan.

2.2 Biosynthesis

50 ml extract of wormwood leaves and 250 ml $AgNO_3$ solution were placed in a 1000 ml flask and reacted at 45 °C after just shaking by hand. The reaction mixture was found to change color with time. The extract obtained as a result of the reaction was centrifuged at 6000 rpm for 15 minutes with an OHAUS FC 5706 device. After several washings, the precipitated solid was dried in an oven at 75 °C for 24 h. The obtained particles were then prepared for characterization. Phytochemicals in plant extracts reduced Ag^{+1} to Ag^0, thus forming AgNPs.

3. Characterization Results

3.1 UV-visible spectroscopy

The visible color change in AgNPs requires the reduction of Ag ions in nitrate ($AgNO_3$). The reaction mixture containing $AgNO_3$ and *Artemisia Lerchiana* extract resulted in the formation of *Artemisia Lerchiana*-AgNPs, which turned into a dark color. UV-vis spectral analysis is used to obtain information about AgNPs. In the absorption spectrum of AgNPs, the resonance band of the hazard plasmon appears in a wide range of 200–800 nm, with a strong absorption band observed at 480 nm (figure 2).

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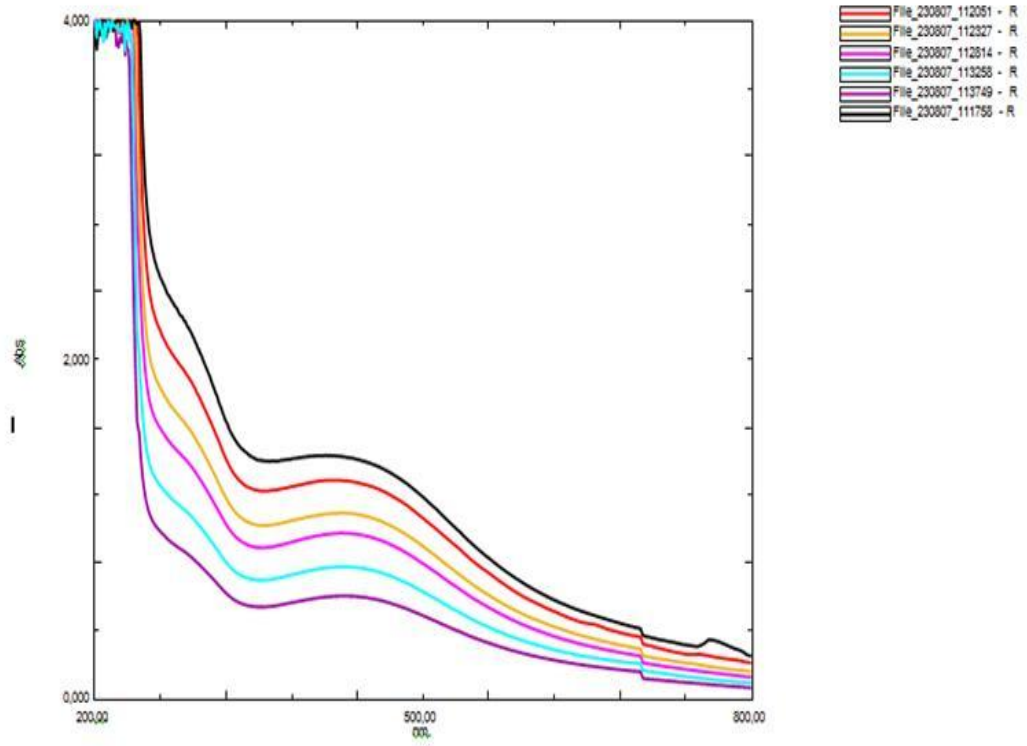
Figure 2. Maximum absorbance value with UV-vis spectrophotometer as a result of interaction of *A. Lerchiana* plant extract and $AgNO_3$ solution



In various studies, the process of conversion of Ag^+ ions into AgNPs has been confirmed using UV-Vis spectroscopy. The UV–Vis absorption spectra of the plant extract the Ag NPs synthesized using *H. muticus* extract were recorded. The spectra showed an obvious absorption peak for Ag NPs between 400 and 500 nm, with a clear peak around 450 nm for all samples in water solvent (Seyyed et al., 2025). In *Senna auriculata* flower extract silver ions were transformed into silver particles, and then the colour changed from yellow to dark brown. The UV–visible spectrum of the synthesized AgNPs was measured at 420 nm has the highest absorbance peak, which was observed at 424 nm, respectively. UV-Vis spectra of the silver surface plasmon resonance band in the aqueous extract of Rubus sanctus Schreber leaves were observed at 436 nm (Hulya, 2025)

3.2 X-ray diffraction (XRD) analysis

The XRD results revealed that the AgNPs prepared by reducing Ag ions with aqueous extract were naturally crystalline and that the X-ray diffraction represented the presence of the characteristic peaks of the XRD pattern that the synthesized material consisted of nanoscale particles. When X-ray light is reflected on any particles, it creates a plethora of diffraction peaks, which represent the physicochemical properties of the crystalline lattice (Bar et al., 2009). Scherrer's formula ($D = K\lambda/\beta \cos \theta$) was used to calculate the average particle size of AgNPs in the *Artemisia lerchiana* Web. plant extract. An intense peak at 2θ 38.04° was chosen to calculate the crystal size, where K is the Scherrer constant, λ is the wavelength of the light used for diffraction, β is the FWHM value of the peak, and θ is the Bragg angle. The Scherrer constant (K) in the formula above takes into account the shape of the particle and is generally taken to have a value of 0.9. As a result of calculations, it was determined that the average crystal size of silver nanoparticles is 24.83 nm (Fig. 3).

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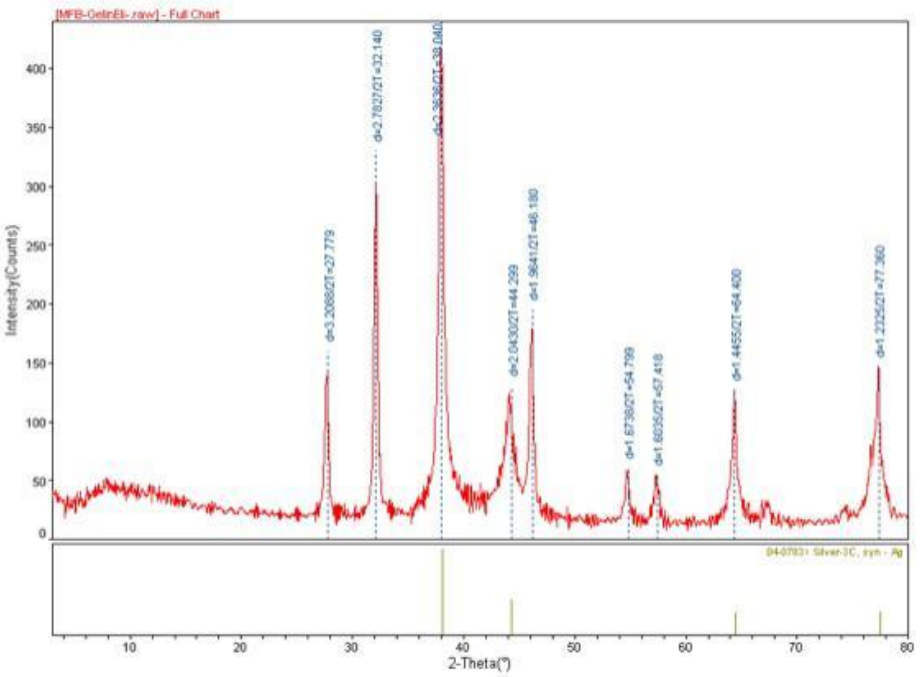

Figure 3. XRD analysis of AgNPs obtained by *A. lerchiana* plant extract

According to the XRD spectrum data of *Artemisia Lerchiana*-AgNPs, the diffraction peaks are at 27.77°, 32.14°, 38.04° , 44.29°, 46.18°, 54.79°, 57.4° , 64.40°and 77.36°, which indicates that silver is cubic represents the crystal structure in the 2θ plane (index).

Several other studies have been conducted. The size of the synthesized silver nanoparticles using Aloe fleurentinorum extract was determined to be 26.87 nm (Yasmin et al., 2024) *Carissa carandas* leaf extract shows the crystalline structure of AgNPs and the size was estimated to be 25.4 nm using Scherrer's formula (Rahuman, 2021).

Conclusion

In conclusion green synthesis method was carried out in biophysical analysis of nanoparticles obtained from Artemisia Lerchiana plant. As a result of UV-Vis spectroscopy, the plasmon resonance peak of the nanoparticles was observed at a wavelength of 480 nm, which confirms the formation of Ag nanoparticles. Based on XRD (x-ray Diffraction) analysis, the crystallite size of the nanoparticles was determined to be 24.83 nm. These results indicate that the Ag nanoparticles synthesized with Artemisia Lerchiana extract have a stable and nanoporous structure.

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Determination of the Sowing Date of Summer Plantings

Abstract

The importance of soil temperature and its impact on planting history.

Soil temperature is one of the main factors for plant germination, root system development and overall productivity. Each plant requires a certain temperature range to germinate. When optimal temperature conditions are created, seeds germinate faster, plants develop vigorously, and yields increase. Correct measurement and analysis of soil temperature plays an important role in planning the planting process. For this purpose, thermometers and special sensors are used. The depth of measurement should correspond to the level at which the seed is planted. For example, for grain crops, temperature indicators at a depth of 5-10 cm should be taken into account.

Soil temperature directly affects the planting date. Three main temperature levels are determined for planting: minimal temperature – the lowest threshold required for the plant to begin germination, optimal temperature – ideal conditions for maximum yield and rapid germination, high temperature – can reduce yield and slow down plant development. The planting date also affects the harvesting process. (AZERTAC G. 2023). When sowing at the right time, the harvest has optimal humidity during harvesting, the risks of drying out and decay are reduced, and effective management of the technique becomes possible. Thus, careful monitoring of soil temperature and choosing a suitable planting strategy increases the overall productivity of the farm and prevents crop losses.

Keywords: *soil temperature, sowing date, yield, germination process, optimal conditions, agrotechnical measures, corn, sugar beet*

Introduction

The minimum and optimal temperature necessary for the plant to germinate

1. Importance of soil temperature

One of the important factors for the germination of plants and the development of the root system is soil temperature. Each plant has an optimal germination temperature, and this directly affects the yield (Babayev, 2019).

2. Soil temperature measurement

To measure the soil temperature, thermometers or special sensors are used. The temperature measurement depth should correspond to the seed sowing depth of the plant to be planted (for example, 5-10 cm for grains).

3. Influence of soil temperature on planting date

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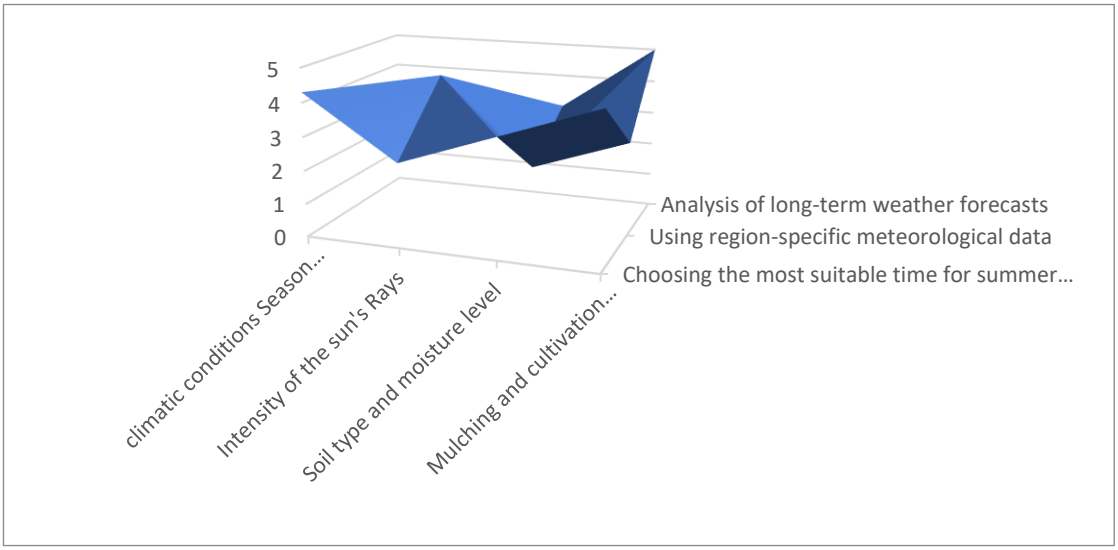
First temperature (minimum required) – minimal temperature so that the plant begins to germinate. Optimum temperature-the temperature necessary for maximum yield and rapid germination (Müller, Klein, 2015).

Research

Type of plant	First germination temperature (°C)	Optimum temperature (°C)
Wheat	1-3°C	12-15°C
Corn	8-10°C	18-22°C
Type of plant	First germination temperature (°C)	Optimum temperature (°C)
Sunflower	6-8°C	16-18°C
Potatoes	7-8°C	15-20°C

Factors affecting soil temperature.
Climatic conditions and season temperatures
Intensity of the sun's Rays
Soil type and moisture level
Mulching and cultivation methods
Choosing the most suitable time for summer plantings
Using region-specific meteorological data
Analysis of long-term weather forecasts
Taking into account the relationship between soil temperature and air temperature

Soil temperature is of great importance for efficient planning of beet and corn plantations in Shamkir district. The optimal soil temperature for germination and development of both plants is different, and this plays a key role in correctly determining the sowing date.



Beet: first germination temperature: beet seeds can begin to germinate at a soil temperature of 5-6°C. However, at this temperature, the germination process is slow and the sprouts may be weak.

Optimum germination temperature: for the best germination and vigorous plant development, the soil temperature should be 10-12°C. Under these conditions, germination is fast and uniform. (Gurbanov, Aliev, 2019).

Corn: first germination temperature: corn seeds begin to germinate at a minimum soil temperature of 8-10°C.

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Optimum germination temperature: the optimum soil temperature for corn is 18-22°C. In this temperature range, germination is fast and uniform, while plants develop healthily (Karimov, Ismailov, 2020).

For example, the history of planting in Shamkir district:

Taking into account the climatic conditions of Shamkir district, it is important to regularly measure the soil temperature in order to determine the sowing date. In general:

Beet plantings: it is advisable to carry out sowing when the soil temperature reaches 10-12°C, that is, usually in late March-early April.

Corn plantings: sowing is recommended when the soil temperature reaches 18-22°C, that is, usually in mid-April - early may.

The temperature of the arable layer of the soil.

Soil temperature changes during the day with a short-term delay from the weather. (Petrov I., &Mammadov L.,2021). For example, in some soil science studies, it is noted that every 10 cm of depth, the soil temperature is observed with a delay of about 2-3 hours. This means that as the depth at which the seed is located increases, the soil temperature is lower during the warmer part of the day. (Shahbaz, 2018).

On the soil surface: average temperature 8°C.

10 cm deep: effective average temperature-about 7°C

15 cm deep: effective average temperature-about 6°C

These calculation rules are based on existing modeling methods and may vary depending on local conditions. The methodology mentioned in the article gives an explanation of the seed germination process at different depths according to the principle of thermal time accumulation (Guliyev, Aliyev, 2020).

Amount of GDD of the plant.

In summer plantings, GDD (Growing Degree Days – harvested effective temperature) is an important indicator for determining the stages of plant development. Periods when the amount of GDD is critical for sugar beet and corn:

Sugar beet.

Germination and initial leaf development (50-150 GDD)

Germination begins when the soil temperature is 5-6°C.

Critical period: if low temperatures and soil moisture are insufficient, germination may be slowed down.

Rosette phase and leaf cover formation (300-600 GDD)

The leaf cover is formed and photosynthesis is enhanced.

Critical period: drought and nitrogen deficiency can weaken the development of leaves. (Ivanova E., & Smirnov A., 2019).

Root growth and sugar harvesting (1000-1500 GDD)

The basis is the stage of sugar collection.

Critical period: drought and high temperatures can reduce the amount of sugar. (Abbasov R.,2018).

Corn.

Germination and early development (100-150 GDD)

The soil temperature should be 10°C.

Critical period: cool air and lack of water can negatively affect germination.

Vegetative development (200-800 GDD)

Leaves and stem grow rapidly.

Critical period: nitrogen deficiency and water scarcity can weaken development.

Flowering and fertilization (900-1300gdd)

It is the stage of pollen propagation and fertilization.

Critical period: high temperatures (>35°C) and drought can reduce the viability of pollen.

Filling and ripening from (1400-1800gdd)

Grains collect starch.

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Critical period: lack of water and frost can reduce productivity.

That is, 1000-1500 GDD in sugar beets and 900-1300 GDD in corn are considered critical stages, since during these periods the balance of water, nutrients and temperature directly affects plant productivity (Maynard, Linder, 2007).

To determine the seed-germination time of Chenopodium album, Amaranthus retro flexus and Amaranthus (albus) species observed in Shamkir district, we present the calculation rules using the thermal time (degree-day) model at a depth of 10 and 15cm.

Weather forecast on the day of the fall of the last frosts in the area over the past 5 years and 2 weeks after the day of planting.

The following steps can be followed to accurately determine the soil temperature:

Measurement depth: soil temperature should be measured at seed sowing depth. For beets, this depth is 2-3 cm, and for corn-5-6 cm.

Measurement time: by taking temperature measurements early in the morning and late in the afternoon, determining the average cost will give a more accurate result.

Regular measurements: it is advisable to monitor the soil temperature for several days before planting and start sowing when the stable optimum temperature is reached.

The last 10 years of frost.

The correct determination of the sowing date in summer plantings directly affects the yield. An important role in this process is played by the date of the last (in 10 years) frosts (frosts), since plants planted after Frost develop healthier and are protected from frost damage. The history of the latter frosts varies depending on climatic conditions and geographical location. For example, in some regions, the last frosts can occur in mid-March, and in others-at the end of April. (Stewart, Glickman, 2019). To determine the date of the last frost, it is possible to use the following sources:

Meteorological data: based on multi-year data provided by official weather forecasting services, the average dates of recent frosts in the region are studied.

The collection and analysis of meteorological data is of great importance, since there is a direct relationship between soil temperature and sowing date. (And Not, 2017). Weather conditions, soil temperature and humidity indicators are some of the factors that are important for the germination and development of plants. By monitoring the temperature regime of the soil through meteorological data, a favorable period for sowing is determined. This minimizes crop losses caused by early or late sowing. At the same time, on the basis of long-term weather forecasts, the irrigation needs of arable land, the risk of frost and periods of drought can also be assessed. Thus, farms can more efficiently plan the planting and harvesting process and achieve high yields using meteorological data.

Local experience: observations from experienced farmers and agronomists can provide valuable information about frost dates in your area. Local practice is traditional knowledge and skills that have been formed over many years in a particular region, applied in agricultural or other fields adapted to local climatic, soil and environmental conditions. These practices are based on the knowledge gained over the years by farmers and agricultural professionals and include optimal methods that match the specific characteristics of the region. Local practice plays an important role in increasing productivity, preserving land and efficient use of resources.

Determining the timing of planting is one of the important factors that directly affect the yield and healthy development of plants. This process requires taking into account a number of environmental and agrotechnical factors (Tunch, 2016). First of all, the soil temperature should be at an optimal level. For each type of plant, the minimum and optimal temperature indicators that ensure germination are different.

When determining the timing of planting after the last frost, it is important to take into account the following points:

Plant species susceptibility to Frost: plant species susceptibility to Frost is determined by their genetic characteristics, stage of development, and environmental factors. Some plants are more tolerant of low temperature conditions, but heat-loving plants such as corn and sugar beets are vulnerable to Frost.Frost can cause frostbite of intracellular water in plants, leading to tissue

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damage and a halt in development. Frost resistance can be increased by various factors, for example, choosing the right planting date, maintaining soil moisture and taking appropriate agrotechnical measures. It is more appropriate to do the planting of frost-sensitive plants after the last frost.

Soil temperature: soil temperature is one of the main factors for plant germination and early development. Each plant has an optimal germination temperature, and this indicator determines how quickly and uniform the seed will germinate. For example, the soil temperature for cereals should be between 5-10°C, and for corn-between 10-12°C. Low temperatures reduce the germination rate of the seed and increase the risk of decay, while high temperatures can disrupt the moisture balance and weaken development (Smith, Nelson, 2014). Therefore, the soil temperature must be constantly monitored, and planting should be carried out in optimal conditions.

Weather forecasts play an important role in the process of planting and plant development. Monitoring short-term weather forecasts is essential to anticipate factors such as expected frosts, temperature changes, rain and wind. In particular, in order to protect frost-sensitive plants, the necessary measures must be taken based on weather forecasts. For example, adjusting the planting time, keeping the soil temperature constant through irrigation methods can prevent frost damage. Therefore, farmers and agronomists should constantly pay attention to weather forecasts and plan their economic activities in accordance with this information (Kuznetsov, Fedorova, 2020)

The role of the 3-week forecast before sowing.

Risk analysis and preparation. The 3-week forecast prior to planting operation helps detect potential cold weather, frost, or unstable weather conditions. During this period, there is an opportunity to delay sowing or take additional measures in accordance with the planned date, assessing the expected weather conditions.

Ensuring Optimal planting conditions. Thanks to the pragnosis data obtained during this time, the time interval during which the optimal soil temperature and moisture level for planting will be formed can be determined with accuracy. This increases the chances of germination of seeds and prevents problems that will arise at an early stage of development.

Practical issues. Careful monitoring of pre-sowing forecast data is necessary both in the preparation of irrigation and fertilization plans, and in the preparation of appropriate technical means (preservation of the quality of seeds, readiness of sowing equipment, etc.) plays an important role in coordination.

The role of the 3-week forecast after sowing.

Monitoring early germination and growth. The first 3 weeks after sowing are the critical period for the germination of seeds and the formation of the first stage of plant development. The weather forecasts obtained in this process indicate what the conditions for the early development of plants (temperature, amount of precipitation, wind speed) will be like. (Kuznetsov, Fedorova, 2020).

Possibility of control and intervention. The post-sowing forecast is if unpredictable weather conditions or risky events (for example, sudden rain, high temperatures, etc.) occur.) if available, it allows you to implement early intervention plans. This is important for taking preventive measures in irrigation, disease and pest control.

Creation of optimal conditions. During this time, on the basis of forecast data, soil moistening, fertilization and other agronomic measures can be planned. These measures create conditions for optimal conditions and healthy growth of plants at the stage of germination and initial development of seeds.

Note: integration of various data collection and integration of various data such as soil temperature, humidity, weather forecasts and local climate statistics are necessary for the correct determination of the sowing date of spring crops. Based on these data, it is ensured that the planting plan is based on scientific foundations.

Assessment of local experience and meteorological data:

By combining data from official meteorological services and the experience of local farmers, the date of the last frost, sudden weather changes and optimal planting dates corresponding to soil conditions can be accurately determined.

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Risk management:

In order to timely detect and prevent factors such as cold weather, Frost, sudden rain and disease risks, appropriate measures (e.g. delaying the planting date, regulating protective equipment and irrigation/drainage systems) should be carried out.

Flexible and predictive planning:

Due to the variability of weather conditions and other environmental factors, planting plans must be flexible. Continuous updating of the sowing date based on forecasts is the main condition for minimizing risks and increasing yields.

Tracking meteorological data:

Using official meteorological services and local practices, it is important to analyze forecasts for 3 weeks and adapt planting plans to it.

Dynamic planning of planting date:

To react to changes in weather conditions, it is important that the plan is flexible, that the planting date can be updated in real time.

Integrated decision mechanism:

The integrated decision mechanism, developed on the basis of weather forecasts, soil temperature, humidity and other environmental factors, is an effective tool in determining the sowing date.

Critical period of plant development (critical period of pollination, fertilization, disease and pests). Stages of plant development.

Pollination and fertilization: this stage vu tests are aimed at the effect of the plant on the skin and proper fertilization. Optimal climatic conditions, temperature and humidity play a huge role in specifying the date of sowing.

Critical period determination: the plant– for example, possible in the fall – the ground, during pollination – weak, and the plant can be stronger against the attack of pests.

Climatic and environmental conditions.

Climatic factors: in the choice of sowing timeit is the role of climatic conditions in the choice of sowing time. Temperature, humidity, wind and intensity of the sun's rays affect the process of pollination and fertilization of the plant.

Environmental impact: microclimate of the Earth impact, soil moisture and other environmental factors contribute to the successful course of the critical period in the development of the plant.

Disease and Pest Management.

Disease risks: the disease (namely, fungal infections) arising at the stage of pollination and fertilization of the plant can affect the yield. The article can talk about the correct installation of preventive devices and treatment methods.

Pest electricity: since the activity of these pests has increased, it is appropriate to mention pest management methods with monitoring systems and integration for their timely detection and management.

Determining the Optimal sowing date.

The danger of Date Selection: Choosing the right sowing date is important for creating optimal conditions in the critical process of plant development. You can give scientific and practical examples from which the effective effects of early or late sowing (in the article, an increase in pests and diseases) are obtained.

Predictive monitoring: the introduction of modern technologies (meteorological data, satellite imagery,) and remedial devices can touch on the determination of sensors and the optimal sowing date.

Weeding type of the site and the minimum temperature at which weeds do not germinate.

1. Black currant (Chenopodium album):

Development temperature: this weed begins to germinate at temperatures above 5°C, and its optimal development is observed between 15-20°C.

2. Asparagus (Stellaria media):

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Development temperature: its germination begins at a temperature of 2-5°C and its optimal development is between 1216°C.

3. Chamomile (Matricariachamomilla):

Development temperature: the minimum temperature for its germination is 4-6°C, and its optimal development occurs between 15-20°C.

4. Chicken millet (Echinochloa crus-galli):

Development temperature: its germination begins at temperatures above 10°C and its optimal development is between 20-30°C.

5. Green bristle (Setariaviridis):

Development temperature: the minimum temperature for germination is 12-15°C, and optimal development is observed between 25-30°C.

6. Panjar (Amaranthusretroflexus):

Development temperature: its germination begins at a temperature of 10-12°C, and its optimal development is between 2530°C.

To combat weeds, agrotechnical measures, mechanical methods and the application of appropriate herbicides are important. For the effectiveness of control measures, it is important to correctly determine the type of weeds and choose the appropriate methods.

Mechanical struggle.

Early plowing (in autumn or early spring) – the soil must be deep plowed to prevent weed seeds from sprouting on the surface.

Disking and cultivation – in spring, when the soil reaches 7-10°c, disc and cultivation can be applied to destroy sprouted weeds.

The black herik method-to keep the site empty for a while before spring plantings and destroy the weeds that have appeared.

Agrotechnical struggle.

Watering before sowing and false plowing – giving a small amount of water to the soil surface and creating conditions for the germination of weeds, and then destroying them by cultivating.

Dense planting technology-planting plants in optimal density limits the development of weeds.

Chemical fight (using herbicides)

Herbicides applied before planting

Glyphosate-based herbicides (for example, Roundup) – weeds can be sown after germination (when they are 5-10 cm).

Herbicides that act on the soil (for example, Pendimethalin) – they are injected into the soil before planting to prevent the germination of weeds.

Herbicides applied after planting

If weeds develop after seed germination, selective herbicides should be used (e.g. dicamba or Mesotrione-based herbicides for corn).

The most effective time.

February-March-the method of the first mechanical struggle or black herik.

March-April-herbicide application and mechanical methods before planting

April-May-selective herbicide use as needed after planting

Calculation procedure (with Degree - day model)

To find the number of days elapsed for the seed to germinate for each variety, we use the following formula:

d = G / (T_effective – T_base)* here:

T_effective-average temperature at the depth at which the seed is located (10°C for 7 cm, 15°C for 6 cm),

T_base-accepted base temperature for each type (about 4°C),

G-thermal time (degree-day) required for germination of the variety.

Chenopodium album

T_base: 4°C

G (required thermal time): approximately 80 degree-day

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10 cm depth:
T_effective = 7°C → daily effective thermal growth = 7-4 = 3°C d = 80/3 ≈ 26-27 days
15 cm depth: T_effective = 6°C → daily effective growth = 6 – 4 = 2°C d = 80 / 2 = 40 days
Amaranthusretroflexus
T_base: 4°C
G: approximately 100 degree-day
10 cm depth:
T_effective = 7°C → daily increase = 7 – 4 = 3°C d = 100 / 3 ≈ 33 days
15 cm depth:
T_effective = 6°C → daily increase = 6 – 4 = 2°C
d = 100 / 2 = 50 days
Amaranthusalbus (albums)
T_base: 4°C
G: approximately 90 degree-day
10 cm depth:
T_effective = 7°C → daily growth = 7 – 4 = 3°C d = 90 / 3 = 30 days
15 cm depth:
T_effective = 6°C → daily growth = 6 – 4 = 2°C d = 90/2 = 45 days
According to the corresponding calculations, if the average air temperature is 8°C:
Chenopodium album:
at a depth of CM, seed germination occurs in about 26-27 days, and at a depth of 15 cm-in 40 days.
Amaranthus retroflexus:
at a depth of CM, germination can be observed in about 33 days, and at a depth of 15 cm-in 50 days.
Amaranthus albus:
At a depth of 10 cm, germination can occur in about 30 days, and at a depth of 15 cm-in 45 days.

These calculation rules are based on existing modeling methods and may vary depending on local conditions. The methodology mentioned in the article gives an explanation of the seed germination process at different depths according to the principle of thermal time accumulation.

The temperature of the day changes like a sine wave. issues, daily temperature recorded data with detailed model:

T (t) = Torta + a ·Sin(2p / 24 (t - tmax))

Here:

T (t) - temperature at any time of the day
T or t A – average temperature during the day
A-temperature amplitude (half of the maximum and minimum temperature difference)
Tmax-the hour at which the maximum temperature of the Day occurs (usually at noon, for example, 14:00) (Martina Hancova, Andrej Gajdos and Jozef Hanc, 2021).

Calculation of average temperature:

If the temperature changes at night (00:00 - 06:00), and during the day it changes differently, then this can be calculated by dividing it into two parts:

$$\text{Torta} = \frac{1}{24}\int_0^{24} T(t)dt$$

If the night temperature creates an additional difference (for example, 3 hours different, then 2 hours different), it is necessary to create a separate model of these differences. For this, separate models such as:

Daytime temperature-changes based on Sinus function.

Night temperature-or, if it is different in hours, it is possible to take another sinus or temperature constant in that hour interval.

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Farm facilities.

You can discuss how modern farming technologies, automation systems, sensors, Geographic Information Systems (GIS) and soil analysis methods increase farm productivity. How the introduction of these technologies affects the economy's innovation and decision-making process can also be highlighted (Petrov, Mammadov, 2021).

Soil quality, irrigation systems and proper management of Water Resources affect its productivity. Facts and methodologies about soil analysis and water resource optimization the construction of the topic can be carried out.

Preparatory Stage.

Analysis of soil and Water Resources.

Establishment of climatic and weather conditions.

Assessment of the capabilities of the farm (equipment, labor, financial resources, etc.).

Strategic planning and planning.

Application Stage.

Building modern technology: farm compatible implementation of Drondrons, sensors and automated systems.

Training and training of personnel: research of employees on new technologies and methods.

Transition to ecological agriculture: application of modern cultivation methods to prevent soil erosion.

Monitoring and evaluation.

Measurement of the results of systems of their implementation.

Identification of problematic directions and carrying out work for improvement.

Collection and analysis of statistical data.

Pivot Irrigation System.

30-50% less water consumption by traditional methods

An even and continuous supply of water to plants is healthier

Effective in different reliefs and different plants

Pivot irrigation conserves resources, increases productivity and improves farm quality.

Harvesting period.

Proper sowing allows you to determine the optimal harvesting time.

Sowing sooner or later can affect the quality and effect of the crop.

Biological characteristics of the plant. The ripening time of each plant is different.

Climatic and weather conditions – temperature, precipitation and sunlight-affect the rate of crop ripening.

Sowing date-the later the sowing, the more delayed the harvesting.

Soil and irrigation conditions-the rate of ripening of irrigated and non-irrigated crops is different. Maximum yield and high-quality assembly of the product:

The optimal level of humidity of cereals and other crops.

Reducing the risks of drying out and decay.

More effective management of the collection technique and employee.

Conclusion

The date of the last frosts is great importance in determining the date of sowing in summer plantings. Waiting 1 week after the last frost ensures the protection of plants from frost damage and allows them to germinate under optimal conditions. This approach contributes to increasing yields and healthy development of plants.

The importance of the weather forecast and the history of sowing. Determining the date of planting is closely related not only to soil temperature and climatic conditions, but also to weather forecasts. Forecasts for 3 weeks before and after sowing ensure the successful implementation of the seed germination and early growth phase, minimizing the risks of the sowing process.

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The harvesting period is closely related to the sowing date. A properly planned sowing and harvesting process increases productivity, reduces losses and increases farm productivity.

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Effect of the Sodium Nitroprusside Inducer on the Concentration of Nitric Oxide and Photosynthetic Pigments Under Stress Conditions

Abstract

Drought and salinity are major global challenges affecting crop productivity, including in Azerbaijan, where grain production is a vital sector. Sodium nitroprusside (SNP), a nitric oxide donor, has shown promise in enhancing plant stress tolerance, but its effects depend on concentration and stress type. This study investigates the impact of SNP on nitric oxide (NO) levels and photosynthetic pigments in the local durum wheat variety *Triticum durum* Desf. Revan under salinity and drought stress.

Wheat seeds were germinated under controlled laboratory conditions and exposed to 0.1 mM and 0.2 mM SNP treatments. Salinity and drought stress were simulated using sodium chloride (NaCl) and polyethylene glycol (PEG-6000), respectively.

Results showed that 0.1 mM SNP significantly enhanced chlorophyll content and NO levels under salinity stress compared to 0.2 mM, indicating a concentration-dependent response.

However, under drought stress, neither concentration of SNP led to significant improvements in NO accumulation or pigment content.

These findings suggest that low-concentration SNP treatment may enhance salinity tolerance in wheat by modulating NO levels and maintaining photosynthetic activity, while its effect under drought conditions appears limited.

Keywords: *wheat, sodium nitroprusside, abiotic stress, salinity, photosynthetic pigments*

Introduction

Wheat cultivation is a historically and economically significant part of industry in Azerbaijan. The wheat plant (*Triticum aestivum*) is one of the most important food crops worldwide. Among cereal grains, wheat has the highest protein content. More than 20% of the daily calorie intake of the world's population is supplied through wheat and wheat-based products (Aliyev et al., 2020).

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As a result of efforts to develop more productive wheat varieties with higher nutritional value, the genetic diversity of cultivated forms has decreased, making them more susceptible to pests, environmental stress, and various diseases (Baloch et al., 2017). Therefore, the use of chemicals to enhance resistance to biotic and abiotic stress factors, as well as their study, is necessary.

Salinity negatively affects seed germination, seedling growth, plant height, yield, and grain weight (Turki et al., 2012).

Exposure of wheat plants to osmotic stress can occur at all stages of development and may lead to cellular damage. The intensity and duration of osmotic stress factors determine the extent of cellular damage during wheat growth (Sarto et al., 2017), which in turn affects growth and development processes, often resulting in reduced yield (Chavoushi et al., 2020).

Research

Osmotic stress caused by drought and ion toxicity can accelerate premature leaf aging, leading to a reduction in chlorophyll content and, consequently, a decline in photosynthetic activity. At the cellular level, high salinity disrupts selective ion uptake due to low water availability, thereby affecting the accessibility of essential nutrients (Trukhachev et al., 2022). The key factor in tolerance to high salt stress is the differential distribution of K^+ and Na^+ ions. One of the most common responses to abiotic stresses is the increase in free cytosolic calcium (Ca^{2+}) levels. This suggests that ion channels could act as mechanosensors (Knight et.al, 2001).

The study of osmotic stress signaling has primarily been conducted on *Arabidopsis*, which served as a foundation for studying stress signals in wheat. During osmotic stress, signal transduction is regulated by both ABA-dependent and ABA-independent pathways. The initial signals of abiotic stresses are transmitted through an increase in reactive oxygen species (ROS) levels. These include singlet oxygen ($^1O_2$), superoxide anion radicals ($O_2^{-}\cdot$), hydroxyl radicals ($HO\cdot$), hydrogen peroxide (H_2O_2) (Reczek et al., 2015).

Studies have shown that the application of sodium nitroprusside (SNP) (200 µM) plays a protective role in preventing oxidative damage caused by salt stress in wheat (*Triticum aestivum* L.) plants (Zhang et al., 2023).

Sodium nitroprusside and their effects on the concentration of nitric oxide and photosynthetic pigments (e.g. chlorophyll) in plants under stress conditions are of great importance. High levels of NO can promote chlorophyll synthesis in plants, which can help increase photosynthesis efficiency. At the same time, NO helps maintain the stability of the photosynthetic system by preventing oxidative stress. By using nitric oxide inducers (such as sodium nitroprusside - SNP), NO production in plants can be increased under various stress conditions. As NO levels rise, the chlorophyll content in plants increases, and photosynthesis efficiency may improve. Nitric oxide can help plants adapt better by regulating their biological response to stress, as well as strengthening their antioxidant system, reducing oxidative damage, and minimizing the loss of photosynthetic pigments (Fancy et al., 2017).

Understanding how photosynthetic pigments, which play a key role in photosynthesis and form the main structure of the photosystem change under normal and stress conditions is of great interest. Therefore, studying the variations in chlorophyll a and chlorophyll b levels in plants under stress conditions is crucial (Trukhachev et al., 2022).

The aim of the research is to demonstrate the effect of sodium nitroprusside as an inducer on the concentration of nitric oxide and photosynthetic pigments in durum wheat under drought and salinity conditions.

Materials and methods

The experiments were carried out on *Triticum durum* Desf. Revan- wheat, genotype which was obtained from the Azerbaijan Research Institute of Crop Husbandry, Ministry of Agriculture. The

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seeds of wheat were pre-treated with 0.2% potassium permanganate for 5 minutes, then, they were planted in 7 cm plastic cups containing neutral substrate (perlite, coco peat). Seeds were sown at a depth of 2-3 cm. The seedlings were grown in a phytotron (Taisite, GZX-300 E) at temperatures of 22–24°C, humidity of 65–75%, and light intensity of 4800 lux. The light cycle was 16/8 hours day/night. As a nutrient medium Steiner's solution was used with the addition of different concentrations of NaCl, PEG-6000 and SNP during the entire growth period, starting from the first days of seedling formation (Fig. 1). Two-week-old fresh leaves of wheat were used for analyses.

Substances	First experiment	Second experiment
SNP	0.2 mM	0.1 mM
PEG-6000	3%	10%
NaCl	100 mM	100 mM
Neutral substrate	Perlite	Cocobit

Table 1. Structure of experiments

The Steiner solution was prepared by adding 100 mL of macroelement-containing Component A, 100 mL of macroelement-containing Component B, 10 mL of microelement-containing Component C, and 10 mL of microelement-containing Component D to 5 liters of distilled water, then total solution was reached to 10 liters. The pH of the solution was then measured and maintained within the range of 5.8–6.3. To achieve this, dilute HNO_3 (nitric acid) or KOH (potassium hydroxide) solutions were used for pH adjustment (Steiner et al., 1961).

To investigate the effects of SNP under drought and salinity stress, six main combinations were formulated using Steiner solution. The media were prepared under controlled conditions to ensure consistency and reproducibility. These combinations served as the experimental treatments for evaluating plant responses to stress conditions.

After preparing the solutions, wheat seeds were treated with them for two weeks, with irrigation occurring 2–3 times per week. The application was conducted under controlled conditions to ensure consistent exposure to the treatment. Morphological analyses of both root and shoot, as well as some biochemical analyses of the shoot of durum wheat, were started on the 14th day of wheat seedling growth.

Determination of chlorophyll a, b, and carotenoid content: The quantification of photosynthetic pigments was performed using a modified method based on Lichtenthaler (Lichtenthaler, 1987). Approximately 0.1 g of fresh green leaf tissue was ground with 5 mL of 96% ethanol to extract chlorophylls and carotenoids. To accelerate the disruption process, quartz sand (SiO_2) was used, while chalk powder ($CaCO_3$) was added to precipitate phenolic compounds. The homogenate was filtered through filter paper into volumetric flasks with a final volume of 25 ml. Any remaining pigments on the filter paper and flask walls were washed with additional ethanol to ensure complete extraction, bringing the final extract volume to 25 ml.

The absorbance of the extract was measured at 440.5 nm, 644 nm, and 662 nm using a Genesys 20 spectrophotometer (Thermo Scientific, Madison, WI, ABS).

Determination of NO content: The determination of nitric oxide (NO) content in the roots and leaves of wheat plants (both control and experimental variants) was performed using a modified method based on Zhou et al (Zhou et al., 2010). Nitric oxide emissions from rice-wheat rotation fields in eastern China: effect of fertilization, soil water content, and crop residue. *Plant and soil*, *336*, 87-98. This method relies on the conversion of endogenous NO to nitrite and the subsequent quantification of nitrite using the Griess reaction (Probes, 2003). In this reaction, sulfanilic acid reacts with nitrite in the presence of phosphoric acid, forming a diazonium salt. The resulting

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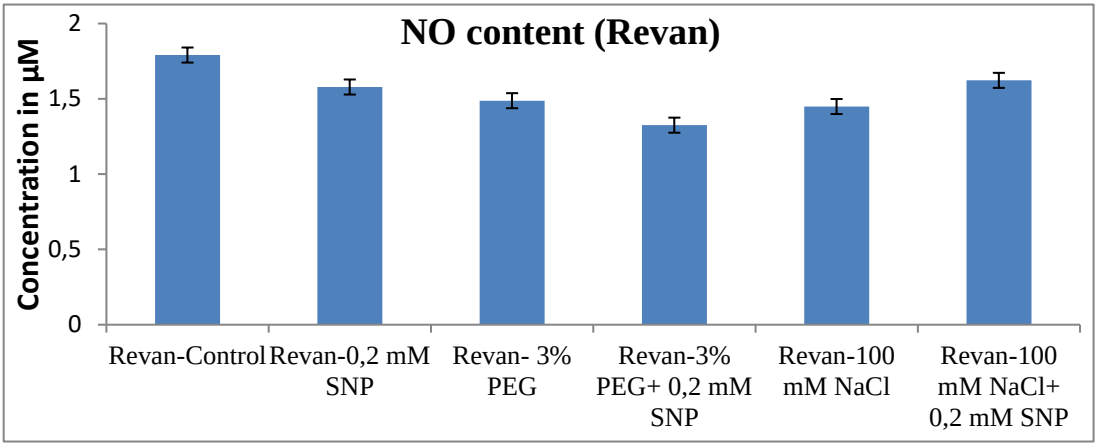
diazonium salt then reacts with N-(1-naphthyl) ethylenediamine to produce an azo dye, which is quantified at a wavelength of 548 nm (Karpets et al., 2015). For the construction of a calibration curve, sodium nitrite solutions of varying concentrations were used.

Statistical analysis: Subsequently, the shoot length and root length were measured, followed by statistical analysis (unit: cm).

Table 4 shows how nitric oxide (NO) levels change in Revan under different treatments. The control group had the highest NO concentration (about 1.8 µM). When 0.2 mM sodium nitroprusside was added, NO levels slightly decreased. Plants treated with 3% polyethylene glycol (PEG), which causes water stress, had lower NO levels than the control. The combination of 3% PEG and 0.2 mM SNP resulted in the lowest NO concentration, suggesting that water stress affects



NO production. Under salt stress (100 mM NaCl), NO levels were lower than in the control but higher than in PEG-treated plants. Adding 0.2 mM SNP to salt-treated plants increased NO levels, showing that extra NO might help plants cope with salt stress.

Table 2. Levels of NO content in the shoot under the effect of 0.2 mM SNP

Table 2 illustrates nitric oxide (NO) concentration in Revan under different treatments. The control group exhibited the highest NO level (~1.6 µM). Treatment with 0.1 mM sodium nitroprusside (SNP) led to a slight decrease in NO levels compared to the control. Plants subjected to 10% polyethylene glycol (PEG), which induces drought stress, showed a further reduction in NO concentration. The combination of 10% PEG and 0.1 mM SNP resulted in a similar NO level, indicating that PEG stress significantly affects NO accumulation. Under salt stress (100 mM NaCl), NO levels were slightly lower than the control but remained higher than in PEG-treated plants. Notably, when 0.1 mM SNP was added to salt-treated plants, NO levels increased, suggesting that SNP application can enhance NO accumulation under salt stress. These findings indicate that NO levels are affected by both drought and salt stress, with drought stress leading to a greater reduction. The addition of SNP slightly affects NO concentration, potentially influencing plant stress responses.

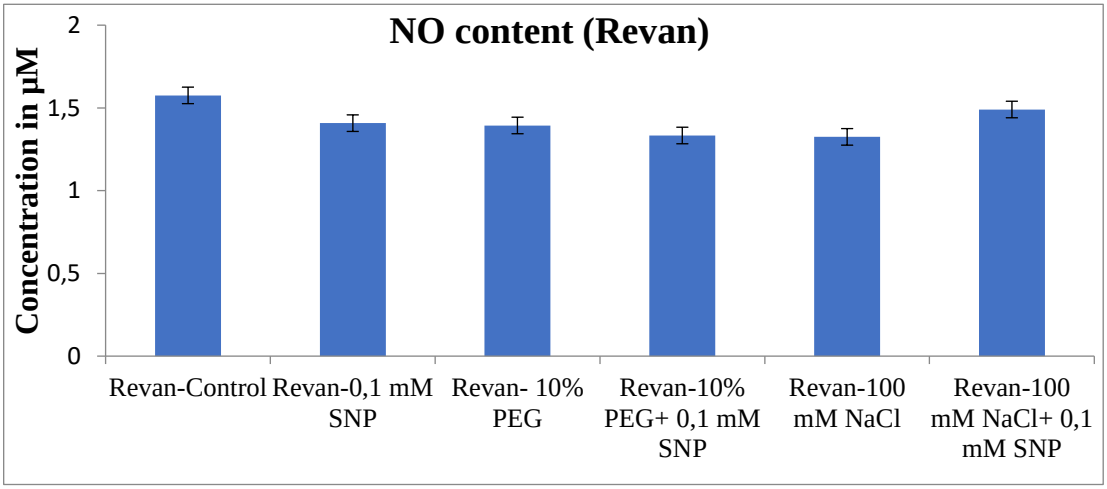


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Table 3. Levels of NO content in the shoot under the effect of 0.1 mM SNP

A comparison of 0.1 mM and 0.2 mM SNP treatments indicates that a higher SNP concentration (0.2 mM) is more effective in modulating NO levels in *Triticum durum* Desf. Revan. Under stress conditions, SNP application generally enhances NO accumulation more significantly in salinity stress than in drought stress. The data suggest that NO metabolism in *T. durum* Desf. Revan responds more favorably to SNP under salinity stress, potentially due to differences in stress signaling pathways. Overall, these findings highlight the concentration-dependent role of SNP in regulating NO levels and suggest its greater effectiveness in relieving salinity stress compared to drought stress.

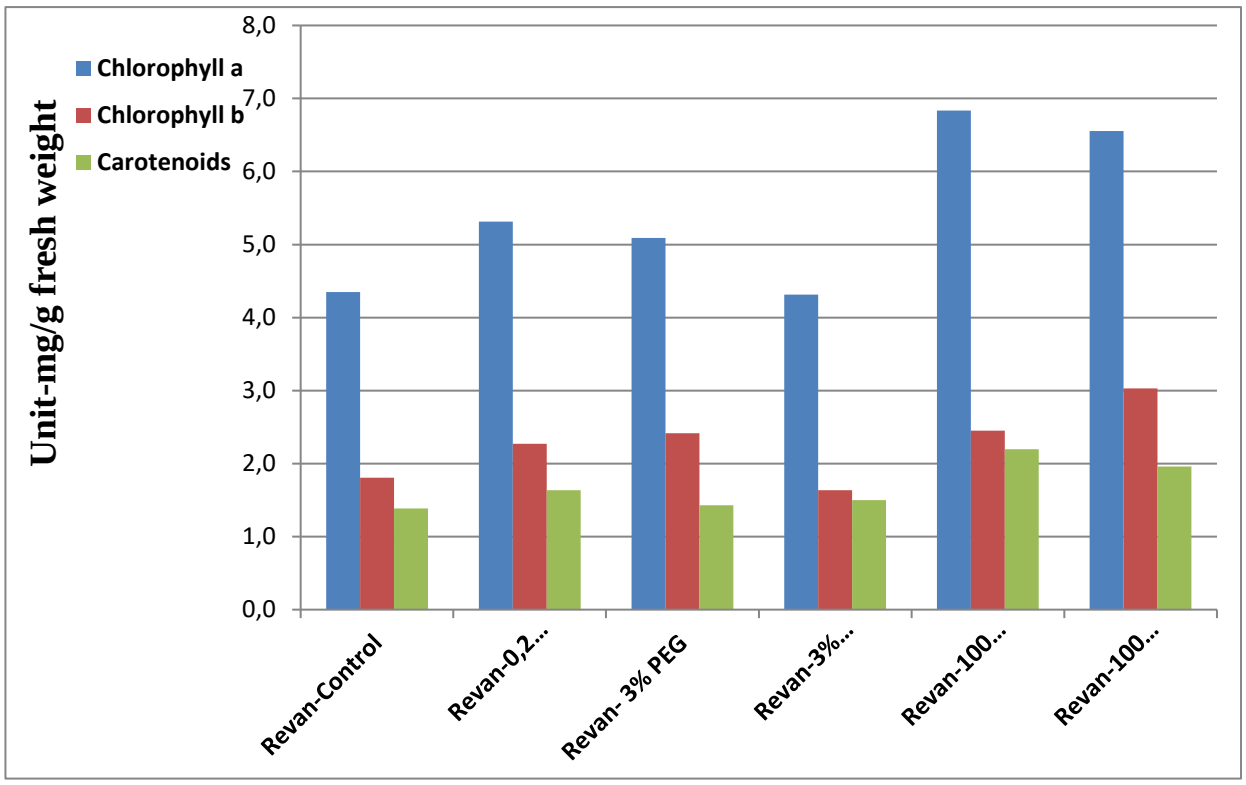

Table 4. Effect of 0.2 mM SNP to the concentrations of chlorophyll a,b and carotenoids. ofn photosynthetic system of T.durum Desf. Revan under drought and salinity stress

The control group shows moderate levels of chlorophyll a, chlorophyll b, and carotenoids. Revan-0.2 mM SNP exhibits a slight increase in chlorophyll a and chlorophyll b, while carotenoids remain relatively unchanged. In the Revan-3% PEG treatment, chlorophyll a and carotenoid levels are slightly in comparison to those in the SNP treated plants, but chlorophyll b decrease slightly, suggesting PEG-induced stress. Revan-3% PEG + 0.2 mM SNP leads to a noticeable reduction in chlorophyll a, b and carotenoids, indicating that SNP might not fully relieve PEG-induced stress. Revan-100 mM NaCl results in the highest chlorophyll a levels, suggesting that salinity stress may enhance pigment production in Revan. Despite the increase in chlorophyll a, chlorophyll b and carotenoids remain relatively stable under 100 mM NaCl, indicating a selective response to salt stress. Revan-100 mM NaCl + 0.2 mM SNP also shows high chlorophyll a levels, though slightly lower than the NaCl-only treatment. Chlorophyll b increases in the Revan-100 mM NaCl + 0.2 mM SNP treatment compared to NaCl alone, suggesting that SNP decreases some salt stress effects. Carotenoid levels in Revan-100 mM NaCl + 0.2 mM SNP are slightly higher than those in NaCl alone, indicating an improved antioxidant response. Comparing 3% PEG and 100 mM NaCl

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treatments, it is evident that salinity stress enhances chlorophyll a, whereas PEG-induced drought stress reduces it.

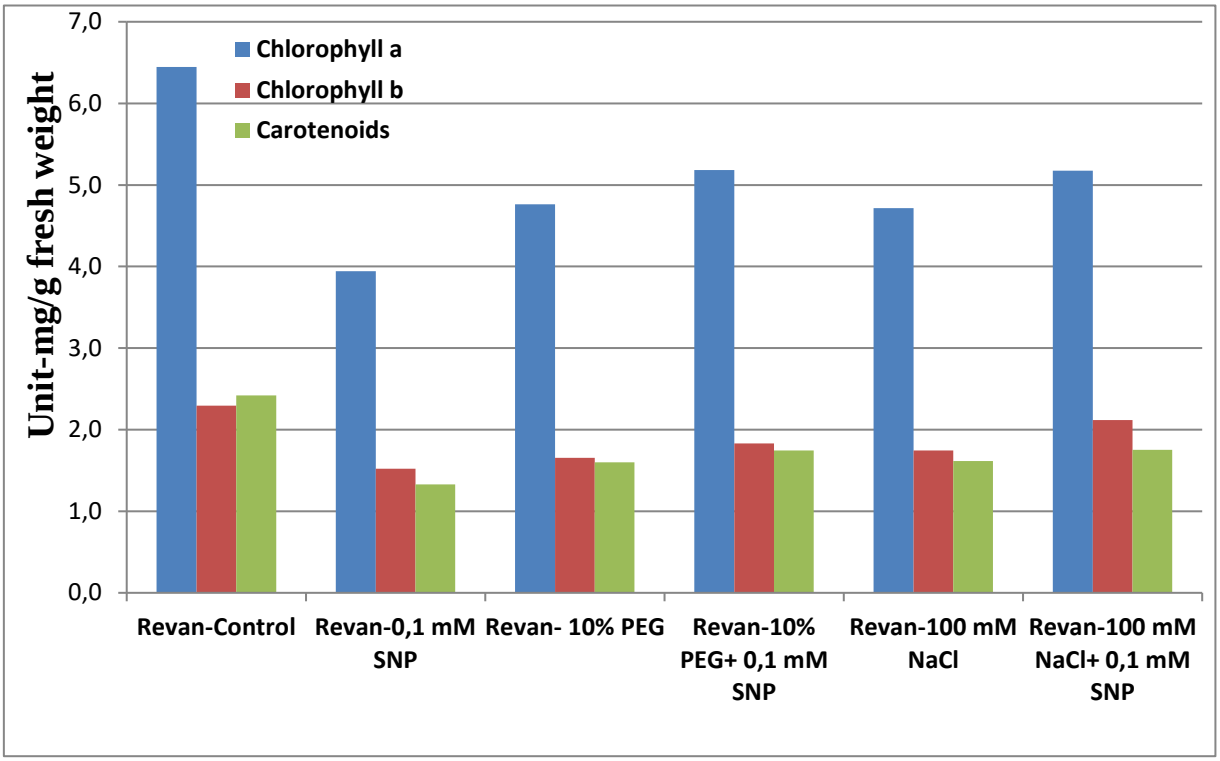

Table 5. Effect of 0.1 mM SNP to the concentrations of chlorophyll a,b and carotenoids. ofn photosynthetic system of T.durum Desf. Revan under drought and salinity stress

The control group has the highest chlorophyll a, chlorophyll b, and carotenoids levels. Revan-0.1 mM SNP shows a decline in chlorophyll a compared to the control, suggesting that SNP at this concentration might have a slight stress-inducing effect. In the Revan-10% PEG treatment, chlorophyll a decreases further compared to the SNP-only treatment, while chlorophyll b and carotenoids remain relatively unchanged, indicating PEG-induced drought stress. Revan-10% PEG + 0.1 mM SNP results in a higher chlorophyll a content than PEG alone. Chlorophyll b and carotenoids also show slight increases in the PEG + SNP treatment compared to PEG alone, supporting the idea of a protective SNP effect. Revan-100 mM NaCl has similar levels of chlorophyll a, b and carotenoid, similar to PEG stress. The Revan-100 mM NaCl + 0.1 mM SNP treatment results in higher chlorophyll a levels than NaCl alone, indicating that SNP has a positive role in maintaining pigment stability under salinity stress. Chlorophyll b and carotenoid content are also slightly elevated in the NaCl + SNP condition, suggesting improved antioxidant potential (Qu, Tian, Zhou, Li, Zhou, Wang, Dong, 2023).

Discussion

Several studies have shown that application of exogenous NO significantly influences biomass accumulation, growth, and yield irrespective of salinity stress. Exogenous NO alleviates salt-induced oxidative damage and improves plant growth and yield potential by regulating osmotic balance, mineral homeostasis, photosynthetic machinery, the metabolism of reactive oxygen species, and the antioxidant defense mechanism (Tahjib-Ul-Arif et al., 2022). NO as a free radical can directly alter proteins, enzyme activities, gene transcription, and post-translational modifications that benefit functional recovery from drought (Santisree et al., 2015). Different

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experiments under drought and salinity stress reveal positive effect on exogenous es application of NO donors, SNP (Cai et al., 2015; Bhardwaj et al., 2021)

Our results also prove that SNP can fight against drought and salinity stress. But still these findings highlight the concentration-dependent role of SNP in regulating NO levels and its greater effectiveness in alleviating salinity stress compared to drought stress. Different studies report varying results: Maslennikova et al. found a decrease in NO content in wheat under salinity stress with 200 µM SNP, while Qu et al. observed increased NO content in soybean under drought stress with rising SNP concentrations. These results are opposite of ours, suggesting genotype-specific responses to SNP and stress itself (Maslennikova, Knyazeva, Vershinina, Titenkov, Lastochkina, 2023).

Green algae and higher plants utilize chlorophyll a and b and a variety of carotenoids to capture light for photosynthesis. Other pigments utilized by photosynthetic organisms, such as chlorophyll c, fucoxanthin, and phycobilins, absorb light in all regions of the visible spectrum. Thus, chlorophylls are light collectors, whereas carotenoids, apart from participating in light harvesting, are also involved in photoprotection. Within the first group, Chl a is present in the reaction centers and the antennae of both photosystems, whereas the presence of Chl b is restricted to light harvesting systems. Among carotenoids, b-Car is almost exclusively located in the core complexes of both photosystems, where it plays an essential role as a quencher of Chl triplets and singlet oxygen. In the literature, application of SNP improves chlorophyll content. Without a stressor, the SNP treatment delayed chlorophyll degradation, thus color was maintained, and shelf-life was extended in broccoli. Relative to the untreated control, the SNP treatment suppressed the activity of the chlorophyll-degrading enzymes, such as chlorophyllase, chlorophyll degrading peroxidase (Shi et al., 2016). Under drought stress, different plants gave signs of improvement by the application of SNP. For instance, Farouk at al. found that SNP application increased chlorophyll, carotenoid, pheophytin a (primary electron acceptor in photosystem II), Chl a and Chl b in marjoram herb (Farouk et al., 2021). Or, the SNP application to the drought-stressed plants increased the Chl b about 3.5 times and had no significant impact on Chl a and carotenoids compared with the drought stressed safflower plants, which is similar to our results (Chavoushi et al., 2020).

Conclusion

Our study investigates the effects of sodium nitroprusside (SNP) on *Triticum durum* to relieve the effect of both drought and salinity stress. As a result of our research, a corresponding increase in the germination rate was observed with the application of sodium nitroprusside. We observed that a 0.1 mM SNP treatment significantly improves chlorophyll content in wheat, showing better results compared to 0.2 mM SNP. Furthermore, the application of SNP under salinity stress leads to an increase in nitric oxide content, highlighting its potential in enhancing stress tolerance. However, when applied under drought stress conditions, the same SNP concentrations did not show any significant improvement in NO levels or chlorophyll content.

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Unsaturated Alcohols and Products Obtained During Their Chemical Transformation

Abstract

Unsaturated alcohols are essential organic compounds, with allyl alcohol being the first representative of this class. It is an industrially significant olefinic alcohol that can serve as a raw material or precursor for the synthesis of various chemical compounds. Numerous important substances are obtained through the chemical transformations of unsaturated alcohols, particularly allyl alcohol. Consequently, the study of their chemical reactions is of great interest. This study focuses on the chemical transformations of unsaturated alcohols, with particular emphasis on oxidation and hydrogenation reactions, as well as their corresponding transformation products.

Keywords: *unsaturated alcohols, oxidation, hydrogenation, saturated, allyl.*

Introduction

Alcohols are classified into saturated, unsaturated, and aromatic alcohols based on the nature of the hydrocarbon radical. Unsaturated alcohols are obtained by replacing the hydrogen in ethylene- or acetylene-type compounds with a hydroxyl group (Babayev, et al., 2024). Unsaturated alcohols are important volatile organic compounds (VOCs) in the atmosphere, and emitted through anthropogenic and biogenic sources. Anthropogenic sources VOCs (AVOCs) are heavily influenced by industrial production and manufacturing. For example, methyl allyl alcohol is an important unsaturated alcohol, mainly comes from chemical process, transport and industry, and the annual output is about 6000 tons in China product (Kunling, et al., 2021). Unsaturated alcohols are

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considered acid-sensitive substances (Li, et al., 2016). Allyl alcohol is the first representative of the class of unsaturated alcohols and an oxygen-containing organic compound. It is a colorless liquid with a pungent, mustard-like odor. Allyl alcohol is soluble in water as well as in many organic solvents, and its chemical structure is CH_2=CH−CH_2OH. It is an industrially significant olefinic alcohol that serves as a raw material and precursor for various chemical compounds. Simple and complex ethers can be easily synthesized from allyl alcohol. Its conversion to acrolein occurs through the mediation of alcohol dehydrogenase. Additionally, allyl alcohol is used in optical resins, protective glass, paints and coatings, polymer cross-linking agents, as well as in the production of pharmaceuticals, organic chemicals, plastics, herbicides, and pesticides (Shashkova, et al., 2024; Mehrnaz, et al., 2024).

Chemical transformation reactions of unsaturated alcohols

Unsaturated alcohols play a crucial role in various industrial applications, particularly in fine chemistry, fragrance production, and pharmaceutical synthesis (Ghomaria, et al., 2014). Unsaturated alcohols from essential oils have been effectively oxidized to their corresponding unsaturated aldehydes using potassium permanganate supported on copper(II) sulfate pentahydrate. Valuable compounds such as geranial and cinnamaldehyde, which are widely used in the food, cosmetic, perfumery, and pharmaceutical industries, were obtained in high yields (>60%) through two activation methods: microwave irradiation and conventional heating (Luu Thi, 2018). Unsaturated alcohols are released into the atmosphere from both anthropogenic and biological sources. While NO_3 radical-initiated reactions of unsaturated alcohols play a significant role in secondary organic aerosol (SOA) formation, they have been less extensively studied. In this research, the rate constants for the reactions between NO_3 radicals and 2-methyl-2-propen-1-ol ($2M_2P_1O$), (E)-4-hexen-1-ol (t-$4H_1O$), and 4-penten-2-ol ($4P_2O$) were determined at 298 ± 2 K using relative rate methods. The obtained rate constants were 3.41 ± 0.51 ($2M_2P_1O$), 6.45 ± 0.66 (t-$4H_1O$), and 0.56 ± 0.15 ($4P_2O$), expressed in units of 10^{-13} cm^3 $molecule^{-1}$ s^{-1} (Lin Hu,et al.,2024).

Research

Allylic alcohols are highly versatile compounds utilized across various industrial processes. The transfer hydrogenation of α,β-unsaturated carbonyl compounds presents an attractive method for synthesizing allylic alcohols. This approach eliminates the need for stoichiometric and hazardous reagents like $NaBH_4$ or $LiAlH_4$. Additionally, unlike conventional catalytic hydrogenations, these reactions do not require specialized equipment such as autoclaves or high-pressure reactors. As a result, transfer hydrogenation protocols are both more cost-effective and safer (Farrar-Tobar, et al., 2018). Pd nanoparticles synthesized from S-dodecylthiosulfate can serve as catalysts for both the isomerization and hydrogenation of allyl alcohol, depending on the solvent used in the reaction. The reaction mechanism involves a Pd-alkyl intermediate, with regioselectivity determined by either the Markovnikov or anti-Markovnikov addition pathways. Generally, nonpolar solvents favor the isomerization of allyl alcohol to propanal, whereas polar protic solvents facilitate its hydrogenation to 1-propanol. Pd nanoparticles capped with shorter alkylthiolate ligands exhibit lower regioselectivity in the isomerization reaction due to the increased surface ligand density of hexanethiolate-capped Pd nanoparticles compared to their dodecanethiolate-capped counterparts synthesized under identical conditions. These findings highlight that manipulating the structure and conformation of alkanethiolate ligands on Pd nanoparticles can lead to the development of highly selective and efficient catalytic materials. Additionally, the exceptional stability of these soluble nanocatalysts is demonstrated by the successful recycling of dodecanethiolate-capped Pd nanoparticles for the isomerization reaction up to 14 times (Elham, et al., 2012). Acrylic acid, the selective oxidation product of allyl alcohol, is one of the most important monomers in the industry. Acrylic acid and its esters are widely used in the production of acrylic fibers, lacquer coatings,

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adhesives, paints, textile auxiliaries, as well as in the paper and leather industries (Babayev, et al, 2024; Ruinan, et al., 2022; Minsu, 2017). The oxidation and pyrolysis of two unsaturated alcohols, prenol and isoprenol, were investigated over a temperature range of 500–1100 K. The study revealed distinct reactivity patterns for each compound, which were successfully captured by a newly developed kinetic model. Isoprenol primarily undergoes a single unimolecular reaction, yielding formaldehyde and isobutene through a six-membered transition state. This reaction mechanism is likely relevant for all unsaturated alcohols with a C=C double bond located at the γ-position relative to the hydroxyl group. Additional oxidation and pyrolysis products in the reactor effluent originate from the secondary reactions of isobutene and formaldehyde. In contrast, the reactivity of prenol is significantly influenced by the different positioning of its double bond, shifting the reaction mechanism from unimolecular decomposition to radical-driven processes. Prenol undergoes typical reaction pathways, such as hydrogen abstraction and radical addition to the C=C double bond, yet the presence of the hydroxyl functional group alters its thermochemical behavior. This leads to limited low-temperature chemistry, resulting in the formation of aldehydes and ketones. Notably, such low-temperature chemistry is absent in the oxidation of 2-methyl-2-butene, despite its structural similarity to prenol (Ruben, et al., 2016).

Conclusion

Unsaturated alcohols are industrially significant compounds, as their chemical transformations yield valuable products. The hydrogenation of unsaturated alcohols results in the formation of saturated alcohols. One such example is the hydrogenation of allyl alcohol, which produces 1-propanol, a widely used solvent and chemical intermediate in various industrial sectors. Additionally, acrylic acid is a selective oxidation product of allyl alcohol. Acrylic acid and its esters are essential for the production of acrylic fibers, lacquer coatings, adhesives, paints, textile auxiliaries, as well as applications in the paper and leather industries.

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Application of Disease-Free Tissue Culture For the Propagation of Sweet Potato (Ipomoea Batatas) Plants

Abstract

The aim of this study was to determine the most effective method for cultivating disease-free mother plants of sweet potato (*Ipomoea batatas* (L.) Lam.) through meristem culture. In this study, Murashige and Skoog (MS) medium (1962) was used as the basal medium. The medium was supplemented with different concentrations of BAP (1.0; 2.0; 3.5 mg/L) and 2,4-D (1.0; 2.0; 3.5 mg/L) to assess their effects on plant regeneration.The regeneration of apical meristems of sweet potato through tissue culture under *in vitro* conditions, followed by subculturing of shoots, enables the production of disease-free plants at a rapid rate. This is a crucial aspect of modern plant biotechnology. The genetic stability of the regenerated plants provides a significant advantage in agricultural production. The results indicated that the highest shoot formation (1.8 shoots per explant) was observed in the medium containing 3.5 mg/L BAP. The medium supplemented with 2.0 mg/L BAP showed superiority in terms of root number, leaf number (8.9), and node number (8.6). The regenerated shoots were transferred to subculturing media containing NAA (1-Naphthaleneacetic Acid). At this stage, the best results in terms of root number (2.5) and leaf number (4.5) were obtained in the medium containing 0.1 mg/L NAA.Despite the establishment of agricultural research infrastructure in Azerbaijan over the past decade, this study represents the first successful propagation of sweet potato using disease-free tissue culture methods in the country.

Keywords: *Sweet potato, in vitro, apical meristems, MS medium, subculturing, BAP*

Introduction

In this study, the in vitro development of sweet potato through meristem culture on nutrient media was investigated. Sweet potato (*Ipomoea batatas* (L.) Lam.) is a cultivated plant with diverse agricultural uses. Traditionally propagated through tuberous roots, sweet potato is susceptible to numerous diseases. One of the most effective approaches for obtaining disease-free mother plants is

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propagation through meristem culture.Sweet potato (*Ipomoea batatas*) is a species of the genus *Ipomoea*, belonging to the family Convolvulaceae in the order Solanales of the plant kingdom. It is rich in vitamins, minerals, and antioxidants (Wikipedia). Also known as sweet potato, it resembles the common potato and is widely cultivated in China, South America, Japan, India, New Zealand, Turkmenistan, and the North Caucasus region. Sweet potato is a heat-loving perennial plant. Its roots are elongated in shape, weighing between 0.3 and 1.5 kg. On average, it contains 72.5% water (range: 7–175%), 3.75% protein, 24% carbohydrates (of which 15–20% is starch and 1.2–2% is sugar), 0.8–1.5% minerals, and 1% cellulose. One hundred grams of sweet potato provides 466 kJ of energy. It contains 397 mg% potassium, 49 mg% phosphorus, 1 mg% iron, and the following vitamins (in mg%): vitamin C – 23, B1 – 0.10, B2 – 0.05, PP – 0.5, and 0.3 mg% carotene (Doroshenko, 2018).

Research

The flesh of sweet potato can be white, red, or pink. It is used in both sweet and savory dishes and is considered one of the beneficial plants for human health (Laveriano-Santos, Lopez-Yerena et al., 2022, p. 11).

Despite the establishment of agricultural research centers with appropriate infrastructure in Azerbaijan over the past decade, the first propagation of sweet potato via disease-free tissue culture methods in the field of biotechnology was carried out by our team. One of the key biotechnological approaches for producing disease-free plant material is propagation through tissue culture (Abbasi, Askari, Bhatti, Rabbani, 2001, p. 23). In addition to allowing for the mass production of plants in a short period, this method also enables the preservation of genetic material under controlled conditions with limited space and labor requirements (Rabbani, Islam, Lee, 2023, pp. 55-63). Producing healthy seedlings in large numbers remains a primary challenge in sweet potato cultivation. To address these challenges, it is essential to implement both traditional and biotechnological breeding programs (Thorpe, 1994, p. 36.). Tissue culture techniques allow the production of disease-free and genetically uniform plantlets (Sonia et al., 2022). Moreover, these techniques are not only used for increasing propagation rates but also for conserving and modifying existing genetic material (Villalba, A., & Martínez-Ispizua, 2024, p. 12).

Sweet potato has shown poor responsiveness to tissue culture and regeneration. Since it is primarily propagated vegetatively, this leads to the spread of virus-infected material, which in turn reduces yield and increases agro-technical costs, discouraging farmers from cultivating this crop (Smith, 2021, p. 4). Additionally, obtaining sufficient vegetative propagules becomes challenging, especially in large-scale farming.The regeneration rate and nature of sweet potato depend on several factors, including genotype and the type and concentration of different plant growth regulators. Thorpe (1994) emphasized the crucial role of plant growth regulators in callus formation, organogenesis, and somatic embryogenesis (Ivanov, 2021). Together with nitrogen sources, these regulators form the basis of the nutrient media, providing essential minerals required for plant growth and development. In this study, the in vitro development of sweet potato via meristem culture on nutrient media was examined. Sweet potato (*Ipomoea batatas* (L.) Lam.) is an agriculturally valuable plant with various uses. It is commonly propagated through tuberous roots, which makes it vul nerable to many diseases. Propagation via meristem culture is one of the most effective methods to obtain disease-free mother plants. Apical meristems of sweet potato were cultured on Murashige and Skoog (MS) medium supplemented with different concentrations of BAP (6-Benzylaminopurine) and 2,4-D (2,4-Dichlorophenoxyacetic acid). The results showed that the highest number of shoots (1.8 per explant) was obtained on medium containing 3.5 mg/l BAP (Klimov, 2019). Meanwhile, the medium with 2.0 mg/l BAP was superior in terms of root number, leaf number (8.9), and node number (8.6). The obtained shoots were subcultured on media containing NAA (1-Naphthaleneacetic acid). At this stage, the best results for root number (2.5) and leaf number (4.5) were obtained on medium with 0.1 mg/l NAA.Through the regeneration of apical meristems under in vitro conditions, subculturing of shoots was performed, leading to the rapid and disease-free multiplication of sweet potato plants. The genetic stability of the resulting plantlets is considered one of the key advantages in sweet potato production (Kiryushin, 2015).

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Materials and Methods

Preparation, Sterilization, and In Vitro Cultivation of Genetic Material

The study utilized the *Nancy Gold* yellow sweet potato genotype. The storage roots of this genotype were cultivated at the Plant Clinic of the Azerbaijan State Agricultural University, from which sprouts were obtained. These sprouts underwent sterilization procedures. Initially, sweet potato sprouts were washed with tap water, followed by surface sterilization. Subsequently, apical meristems were isolated under a binocular microscope with 10×40 magnification and transferred to a nutrient medium (Naidoo, Laurie, 2022).

Figure 1. Rooting of sweet potato plants

Figure 2. Obtaining sweet potato seedlings in invitro conditions

MS (Murashige and Skoog, 1962) medium was used as the basal medium in this study, prepared with different concentrations of BAP (1.0; 2.0; 3.5 mg/L) and 2,4-D (1.0; 2.0; 3.5 mg/L). The cultivation process was conducted at 26°C with a light intensity of 1500–2000 lux, following a 16-hour light and 8-hour dark photoperiod. The in vitro cultivation process was designed according to a Randomized Complete Block Design with two replications. The nutrient media were sterilized by autoclaving at 121°C and 1 atm pressure for 20 minutes.Measurements were conducted for regenerated plantlets, including shoot number, shoot length (cm), root number, root length (cm), leaf number, and internode number. The obtained in vitro plants were transferred to MS (control) and MS + NAA (0.1; 0.5 mg/L) media for microclonal propagation (Mahmood, Moore, Tommasi, Simone, Colman, Hay, Pizza, 1993).

Results and Recommendations

Statistical analysis of the *Nancy Gold* sweet potato genotype under control and nutrient media conditions revealed that shoot number, root number, and internode number were significant at $p \leq 0.01$.In terms of shoot number, the MS + 3.5 mg/L BAP medium exhibited the highest result, with 1.8 shoots per explant. The media containing 1.0 and 2.0 mg/L BAP, along with 1.0 mg/L 2,4-D, showed identical results with 1.0 shoot per explant (Pasha, Arshad, Ahmad, Raza, 2022).

Regarding root number, the MS + 1.0 mg/L BAP medium yielded the highest value, with 5.0 roots per explant. In terms of leaf number and internode number, the MS + 1.0 mg/L BAP medium also exhibited the highest values, with 9.5 and 5.5, respectively. The cultivation of *Ipomoea batatas (L.) Lam.* apical meristems in nutrient media containing different concentrations of BAP and 2,4-D demonstrated that the medium with 3.0 mg/L BAP was the most effective in terms of shoot number, while the medium with 1.0 mg/L BAP was superior in root number, leaf number, and internode number. Based on all evaluated parameters, it was determined that media containing low concentrations of 2,4-D promoted shoot formation, whereas higher concentrations inhibited shoot

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development and predominantly stimulated callus formation (Statista, 2024). These findings suggest that BAP-containing media promote shoot development, whereas 2,4-D-containing media enhance both shoot development and callus formation. The in vitro regenerated sweet potato plantlets were subcultured, and the medium containing 0.1 mg/L NAA demonstrated superior results in shoot height, root number, root length, and leaf number. For the *Nancy Gold* genotype, the application of cytokinins at low concentrations in in vitro conditions is recommended. Additionally, media containing low doses of auxins were found to be suitable for subculturing and significant for commercial production due to their cost-effectiveness (Zhou, et al., 2020).

Figure 3. Obtaining sweet potato seedlings under in vitro conditions

Conclusion

In addition, obtaining disease-free sweet potato seedlings through apical meristem culture can provide a significant advantage for commercial production. This approach allows for the establishment of healthy mother stocks and the enhancement of sweet potato production potential through in vitro methods. Consequently, this could promote the commercial cultivation of this relatively unknown crop in our country. Furthermore, an efficient and economically viable laboratory protocol for the in vitro regeneration of sweet potatoes can be developed.

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The Potassium Channels are an Important Target in Cancer Therapy

Abstract

Potassium (K^+) channels play a key role in the functioning of human physiological processes. Potassium channels are transmembrane proteins that are frequently aberrantly expressed in tumors and are directly involved in tumor progression. Various molecular mechanisms implicate the irregular functioning of potassium (K^+) channels in the formation of cancer hallmarks such as proliferation, migration, invasion, and apoptosis. Recent studies continue to accumulate evidence of successful testing of K^+ channel-targeting agents in animal tumors. These data demonstrate that interfering potassium channels in combination with existing treatments may significantly improve cancer treatment. Thus, the potassium channels represent an underexplored avenue for cancer therapy and it was developed a diversity of drugs for anti-cancer effects by modulating potassium channels in tumor cells. In this paper, we provide a brief overview of the role of potassium channels in cancer cell formation and their potential targets in tumorigenesis therapy.

Keywords: *potassium channels, channel overexpression, cancer therapy, drug designing, tumor biology*

Introduction

Much of the effort in cancer research in recent years has focused on identifying new targets for treatment (Daneshmand et al., 2016). The generally accepted concept is that identifying new targets will develop new strategies to combat previously untreatable cancers (Garattini, 2003; Mokhtari et al., 2017; Schwartz & Shah, 2005). In this context, ion transport molecules have been repeatedly proposed as potential targets, as they are often involved in cancer biology (Huang & Jan, 2014).

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Among the family of ion transport molecules, potassium channels have the highest variability in their biochemical structure and role in cancer **(Figure 1)**.

Research

However, inhibition of mechanisms induced by potassium channels may have therapeutic potential, as with chloride channel inhibitors already used in clinical trials for glioma patients. A greater therapeutic potential lies in the disruption of potassium channel mechanisms involved in tumorigenesis (McCoy & Nimigean, 2012). $K_v10.1$ is a channel that appears to trigger malignant transformation and has been extensively studied in mice. Using a bioinformatic approach, imipramine, one of the most potent blockers of $K_v10.1$, has been proposed as an efficient target for the treatment of non-small cell lung cancer. However, $K_v10.1$ can also be attacked by specific drugs because its function — at least outside the central nervous system — does not appear to be crucial in normal tissues. This is because several million people have taken astemizole or terfenadine, both drugs that are effective $K_v10.1$ blockers and have fewer side effects. This remains to be elucidated, as KCNG3-knockout mice have no obvious phenotype. However, further studies on other potassium channels discussed in this context may determine their role in signaling cascades leading to or favoring malignant transformation. This will contribute to a better understanding of the role of potassium channels in both tumor tissues and their microenvironment.

Molecular-structural organization of the potassium channel

Potassium channels are transmembrane proteins defined by their ability to selectively facilitate the permeability of K^+ ions between the intracellular and extracellular environments (Li et al., 2023; Younes et al., 2023). In the presence of ion channels that facilitate the movement of specific ions, the electrochemical gradient also generates a membrane potential used as a signaling mechanism to control the transport of many molecules.

Membrane potential depends on the concentration of ions on both sides of the membrane. Ion channels provide specific ionic conductance, and their opening results in ion flow down the electrochemical gradient. Thus, the membrane potential changes. In the case of permeation for a single ion, this equilibrium potential depends only on the concentration of ions on either side of the membrane. The all ions moving across the membrane surface are K^+ ions, resulting in a negative membrane potential outside the cell. K^+ ions can also move through nonselective cation channels, in which case their activation balances the concentration of ions on both sides of the membrane, which leads to a violation of the membrane potential (Kim & Nimigean, 2016).

K^+ channels can be classified according to their stimulus-response, conductance properties, and structural criteria (Kopec et al., 2019). Thus, there are four classes of K^+ channels: voltage-gated potassium channels, calcium-activated potassium channels, inward-rectifying potassium channels, and dipore potassium channels (McCoy & Nimigean, 2012). There are a total of 77 genes encoding potassium channels and these are grouped into gene families KCNA, KCNB, KCNC, KCND, KCNF, KCNG, KCNH, KCNJ, KCNK, KCNM, KCNN, KCNQ, KCNS, KCNT, KCNU4 and KCCNV. The conductance properties of K^+ channels result from the presence of evolutionarily conserved "signature" sequences that constitute the selectivity filter, except that some potassium channels may have substitutions in the selectivity filter sequence (Shealy et al., 2003). K^+ channels generally have a conserved structure consisting of two transmembrane domains and two pore-forming P-loops. This minimal structure is identical to the ATP-sensitive inwardly gating potassium channels - $K_{ir1\text{-}6}$ - activated by external mechanisms. In some cases, for example, ATP-dependent channels form a complex with the protein SUR1, which senses the concentration of ATP and causes the channel to close in the presence of ATP (Martin et al., 2017).

In other cases, the α-subunit of the G protein is responsible for opening the channel. Inward channels usually play a role in the flow of K^+ ions into and out of the cell depending on the electrochemical gradient. Still, they often facilitate the outward flow and shift the membrane potential to a negative equilibrium for K^+. 39 genes encode members of the Kv family (voltage-gated potassium channels, Kv1-12) and have a voltage sensor with four additional transmembrane loops.

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Calcium-activated potassium channels (K_{Ca}) share the same structure as the K_v family. Still, except for the calcium-activated potassium channel α1 subunit ($K_{Ca1.1}$), they are voltage-independent and activated by intracellular Ca^{2+} ions **Fig. 1,** (Guéguinou et al., 2014; Javaherian et al., 2011; Yusifov et al., 2008; Yusifov et al., 2010). The structural basis of ion selectivity in K^+ channels has been extensively studied using the prototypical K^+ channel, KcsA, as a model system (Xu & McDermott, 2019). It was clear that the conserved sequence of TVGYG amino acids was preserved in its selectivity filter. In this channel, TVGYG only binds K^+ ions and can block other ions. Overall, such selectivity properties and overexpression of potassium channels are known to affect tumors and various processes during the cell cycle.

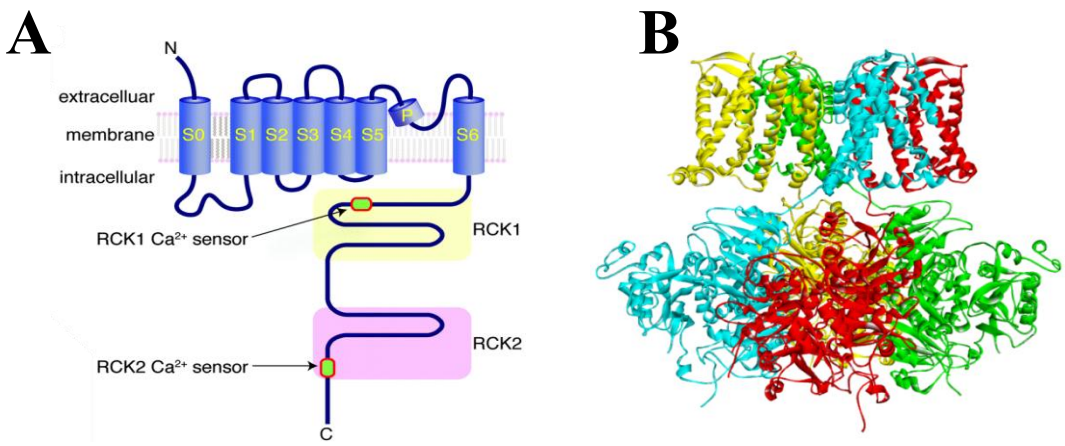

Fig. 1. Model of structure and function of the BK channel. (A) Topology of BK channel showing the extracellular N-terminal region, the transmembrane domain composed by the voltage sensor and pore domain (P), and the intracellular C-terminal domain (CTD) where the RCK1 and RCK2 Ca^{2+} binding sites reside. (B) The atomic structure of the human BK channel was obtained using Cryo-EM structure (PDB:6V3G.) Each subunit is shown in different colors. The images were rendered using Discovery Studio Visualizer 2024.

The potassium channels play an important role in the formation of cancer hallmarks

The highly abnormal expression of potassium channels in tumors is common to many tumor types **Fig. 2** (Kopec et al., 2019). Changes in the expression levels of K^+ channels occur at the genomic, transcriptional, post-transcriptional, translational, and epigenetic levels, which are explained by changes in the regulatory region. For example, the activity of $K_{v11.1}$, member H of the voltage-gated potassium channel subfamily, is enhanced by interaction with β1-integrin and β-catenin, and $K_{v10.1}$ is activated by epidermal growth factor receptor (EGFR) (Breuer et al., 2019). In some breast cancer cell lines, the expression of $K_{2P5.1}$, a member of the potassium channel subfamily, is increased by estrogen receptor-α activation, and channel activity is reduced, which reduces estrogen-induced proliferation of breast cancer cells, which, suggesting that the expression of the channel is involved in the response to estrogenic stimuli. In other channels, the gene encoding the T1-domain protein encodes the potassium channel regulator (KNCRG), which reduces potassium currents and cell surface K^+ channel expression in cancer cell lines (Usman & Mathew, 2010). KCNRG also reduced proliferation and increased apoptosis in tumor cells in vitro, but did not affect cell migration and aberrant cell death. Epigenetic mechanisms such as DNA methylation have been implicated in the altered expression of KCNH5 in non-small cell lung cancer, KCNH2 in clear cell ovarian cancer, and KCNA3 in pancreatic cancer and poorly differentiated breast cancer (Lei et al., 2023). Alterations in histone acetylation have been implicated as a source of aberrant expression of $K_{v10.1}$ in head and neck cancer. As an exception, naturally occurring mutations in the P-loop in the $K_{ir3.4}$ channel result in loss of ion selectivity, leading to increased Na^+ conductance and thus cell depolarization. This, in turn, results in increased aldosterone secretion and proliferation, leading to aldosterone-producing adrenal adenomas and hypertension.

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However, most of the mechanisms leading to the loss of regulated expression of potassium channels in tumors are still poorly understood. If K^+ expression were not essential for $K_{v10.1}$ tumorigenesis, mere inhibition of the channel would not have a strong effect on tumor growth. However, because open channel blockers bind the protein in an activated conformation, they prevent the conformational changes that occur in response to stress. Indeed, pharmacological inhibition of channel activity by small molecules or monoclonal antibodies has shown efficacy in mouse xenograft models of breast and pancreatic cancer (Daneshmand et al., 2016). In addition, the selectivity of $K_{v10.1}$ expression makes it possible to use this channel as a target for the delivery of cytotoxic compounds or cytokines. For example, a fusion protein consisting of a ligand (TRAIL) that recognizes an extracellular epitope on $K_{v10.1}$ induces the programmed death of $K_{v10.1}$-positive and $K_{v10.1}$-negative tumor cells and induces fratricide (immune T cell) (Selvakumar et al., 2022; Song et al., 2016).

Potassium channels have been found to influence cell migration in many cell types strongly. In this context and depending on the tumor type, calcium-activated potassium channels are important among different ion channel families, for example, $K_{Ca1.1}$ and $K_{Ca3.1}$ are critical for glioma cell migration (Catacuzzeno et al., 2021). Indeed, activation of $K_{Ca1.1}$ by ionizing radiation can increase the motility of glioma cells after radiotherapy in vitro, leading to therapy failure (Selvakumar et al., 2022). In contrast, members of the small-permeability family of calcium-activated potassium channels are relevant for the migration and metastasis of colon, melanoma, and breast cancer cells. Inhibition of $K_{v10.1}$ among voltage-gated channels successfully reduces the migration of leukemia and breast cancer cells in vitro (Tanner et al., 2019). $K_{v11.1}$ has been implicated in the migration of leukemia, thyroid, and melanoma cells. In all of the above cases, potassium channel inhibition reduces cell migration, and therefore potassium channel inhibition is predicted to reduce metastatic potential (Song et al., 2016).

The spread of cancer cells to healthy tissues and organs, in short, metastasis, is an important event for tumor development. During this process, cancer cells detach from the substrate, move to a new position, and reestablish adhesion at the new location. It has been argued that potassium channels have a role in each step of these processes. Potassium channels are also associated with integrins, which are key initiators of cell adhesion signaling in physiological situations.

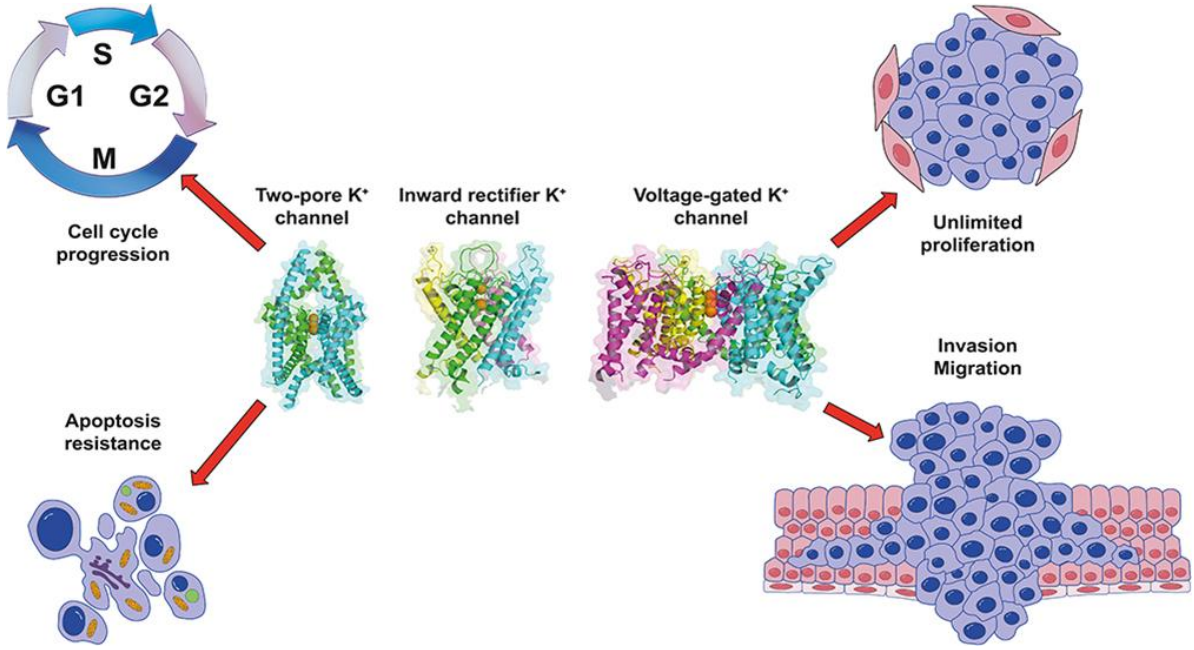

Fig. 2. Roles of K^+ channels in cancer hallmarks formation. Cellular processes associated with changes in expression and increased activity of the K^+ channels: two-pore domain K^+ channel (K2P), the inward rectifier K^+ channel (K_{ir}), and the voltage-gated K^+ channel

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(K_v) in cancer. K^+ channels structure in ribbon representation were generated with the PDB 6RV2, 7S5Z, and 7WF4 (Zúñiga et al., 2022).

The $K_{v11.1}$ channel was among the first voltage-regulated channels identified to be directly linked to cancer. The involvement of potassium channels in cell adhesion signaling is demonstrated for $K_{v11.1}$, which physically interacts with β1 integrin. Activation of β1 integrin results in long-term activation of $K_{v11.1}$ (He et al., 2020). The membrane potential of neuroblastoma cells has also been suggested to be controlled by the expression of an inward regulatory channel identified as $K_{v11.1}$. It was soon discovered that $K_{v11.1}$ is highly expressed in many types of cancer. Of these, the most studied are blood and colon cancers, but there is evidence of overexpression in many other tumor types. However, KCNH2 appears to be epigenetically silenced in clear-cell ovarian carcinoma, suggesting that increased expression of $K_{v11.1}$ is not essential for tumorigenesis in all cancer types. Inhibition of $K_{v11.1}$ function reduces tumor cell proliferation in vitro and in vivo (Arcangeli & Becchetti, 2010; He et al., 2020). Therefore, this channel potentially presents a new avenue for therapeutic intervention.Aberrant expression of potassium channels is frequently observed in tumors and can alter tumor behavior in various ways and confer advantages on tumor cells. For example, $K_{v11.1}$ channel activity has been implicated in the chemoresistance of tumor cells and has been shown to have prognostic significance in colon, head and neck, ovarian, and gastric cancers. $K_{v11.1}$ channel expression can predict malignancies in skin cancer, ovarian carcinoma, acute myeloid leukemia (AML), and head and neck cancer (can be used as an anchor marker). The association of $K_{v10.1}$ with AML is exciting because this channel helps determine the choice of treatment regimen in AML. In addition, expression levels of $K_{v10.1}$ may also be useful as a human papillomavirus (HPV) marker (Agarwal et al., 2010; Martínez et al., 2015).

Conclusion

Potassium channel interference potentially offers a new therapeutic window for cancer treatment. Specific concerns about channel targeting in normal tissues, such as potential side effects, can be addressed in several ways. In some cases, the channel is preferentially expressed in tumor cells. In other cases, the aberrantly expressed form differs from the physiologically normally expressed form. It is often possible to mechanistically dissociate functions in normal cells and tumor cells, so it should be possible to predict and implement combination therapies that improve the efficacy and specificity of traditional chemotherapies. In addition, ion channels are extracellularly accessible, a feature that simplifies drug design. In many cases, the rational design of new treatments leads to direct or indirect inhibition of cell growth factor receptors, leading to a significant life expectancy increase for patients with specific tumor types. Therefore, a new approach such as interfering with potassium channels in combination with existing treatments may significantly improve cancer treatment. Altogether, these properties warrant intensive investigation of the potential of K^+ channels as targets for the treatment of cancer(s).

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Mycobiota of Orchards Cultivated in Azerbaijan and the İmpact of These Fungi on Physiological Processes in Plants

Abstract

In the conducted studies, a number of fruits distributed in the Greater Caucasus part of Azerbaijan were analyzed according to fungal microbiota. The majority of recorded fungi, more precisely 96.3%, belong to true fungi (Mycota or Fungi), and 3.7% belong to fungus-like organisms (Chromista). Most of the recorded true fungi, more precisely 67.0% (64.4% of total fungi) belong to Ascomycota, 26.0% (25.0%) to Basidiomycota, 6.8 % (6.5%) belongs to zygomycetes (Mycormycota). Parasitic fungi such as *Alternaria, Erysiphe, Puccinia, and Phytophthora* damage plant tissues by causing diseases such as powdery mildew, rust, and root rot, respectively, and cover the leaf surface by causing necrosis and spots on the leaves, destroying tissues, and thus reducing the photosynthetic capacity of the plant. Fungi of the genus *Fusarium and Phytophthora* damage plant roots, impairing water absorption by the roots, disrupting the water balance and causing wilting. Some fungi also disrupt the hormonal balance in plants by secreting hormones and toxins.

Keywords: *mycobiota, plant physiology, phytopathogenic fungi, prevalence rate, physiological processes*

Introduction

The territory of the Republic of Azerbaijan consists of ecosystems of different nature, and each ecosystem carries specific characteristics along with the general signs of the nature of Azerbaijan. It should be noted that, 8 of the 11 climate types are found in the not so large territory of the Republic of Azerbaijan. Such diversity has also influenced the flora of Azerbaijan and in the studies carried out so far, the distribution of about 5000 plant species has been determined in the territory of the Republic of Azerbaijan. The recorded plants are characterized by a wide diversity according to their taxonomic structure, life forms, purposes, resources, areas of use and other features (MycoBank).

It's no secret that plant-based products are an indispensable component of people's diet. Therefore, in the studies conducted in terms of providing the population with fruits, fresh vegetables and melon products, plant varieties with high productivity have been created, and currently they are widely used in the purchase of targeted products. Nevertheless, a certain part of the products obtained every year is lost due to various reasons, among the main reasons for this, diseases caused by various living things occupy an important place (Ellis, Ellis, 1987). It is no coincidence that today there are extensive researches on its prevention all over the world, and today this issue is one of the tasks that cannot be solved within any specific country. Thus, the role of the border factor in the spread of diseases caused by microorganisms is not so great. sing microorganisms in various groups of plants are also being studied (Bakshaliyeva, Babashlı, Yusifova, 2021).

Research

Among these types of diseases, those caused by fungi are of particular importance, at least because the loss of yield during the epiphytoty of a disease caused by this or that fungi is sufficient, and sometimes even results in this product being completely useless. In general, it is estimated that at least 10% of the world's crop production is lost due to fungal diseases, which is expressed in millions of tons (Savary, Willocquet, Pethybridge, 2019). In addition to these negative effects that manifest against the background of various diseases, fungi also have properties that stimulate physiological processes in the plant body and have a positive effect on plant development.

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Therefore, the purpose of the presented work is to study the species composition of the mycobiota of fruits cultivated in Azerbaijani conditions and to investigate the changes occurring in the physiological processes of these fungi in the plant organism (Chatterjee, Kuang, Splivallo, 2016).

Material and methods

Research has been conducted since 2021 in various economic regions of the Republic of Azerbaijan. For this purpose, samples were taken from the vegetative and generative organs of fruit plants cultivated in the mentioned areas and were analyzed according to the set goal. In taking samples, were used methods of selecting permanent areas for planned route and stationary observations, which are widely used in the course of mycological research (Bilay, 1982). In total, more than 1050 samples were taken and analyzed during the research. For the taking fungi to the pure culture were used standard nutrient mediums - Suslo agar, Saburo agar, Potato agar and agarized Chapek medium. The media were prepared, sterilized and poured into Petri dishes according to known methods (Bilay, 1982). A sample suspected of having a fungi is transferred to a nutrient medium and placed in a thermostat (260 ^{0} C) for a certain period of time (up to 10 days) until a colony is formed. After a colony or clump of mycelium is formed, it is re-inoculated into a clean medium for visual purity, and this process is continued until a pure culture is obtained. The purity of the culture is monitored with the help of a microscope (Semenkova, Sokolova, 2003). During the whole process, the day of colony formation, shape, color, color of the back side, smell, shape of mycelia, formation of conidia and other derivatives and changes in their shapes, sizes, etc. are recorded, and identification of mushrooms is carried out based on the determinants (Khokhryakov, Dobrozrakova, Stepanov, Letova, 2003) drawn up on the basis of cultural morphological and physiological characteristics. The impact of fungi on physiological processes in plants was determined by clarifying observations made in studies and literature data (Fernando, 2012).

Results and discussion

From the result of the analysis of samples taken from fruit plants cultivated in different areas of Azerbaijan, became clear that the number of fungi distributed in the studied plants is equal to 216. The majority of recorded fungi, more precisely 96.3%, belong to true fungi (Mycota or Fungi), and a small number (3.7%) belong to fungus-like organisms (Chromista). Most of the recorded true fungi, more precisely 67.0% (64.4% of total fungi) belong to Ascomycota, 26.0% (25.0%) to Basidiomycota, 6.8 % (6.5%) belongs to zygomycetes (Mycormycota) (Sutton, Fothergill, Rinaldi, 2001). Among the recorded fungi, a number of genera participate in the formation of the mycobiota of the studied cultivated plants with a number of 10 or more species, here includs genera *Alternaria, Aschochyta, Aspergillus, Colletotrichum, Fusarium, Pencillium, Rhizopus, Septoria, Trichoderma, Verticillium* (Jain, Sarsaiya, Wu, Lu, Shi, 2019).

The fungi recorded in the studies differed from each other in terms of their ecotrophic relationship to the fruits studied. Thus, among the recorded fungi, both true biotrophs (*A. alternata, A. mellea, Asc. fagi, A. niger, A. versicolor, Botrytis cinerea, E. communis, E. deformans, E. amygdale, F. fomentarius, G. confusum, T. discolor, T. pruni-spinosae and U. salviae*) and polytrophs (*C. puteana, F. annosa, F. cyticinia, F. pinicola, G. lipinse, Ph. igniarus, P. ostreatus, Sch. commune, T. hirsuta and T. versicolor*), that is, those that do not have a true saprotrophic and biotrophic nature, were found. These fungi are mainly universal in terms of the nature of the pathology they cause in the studied plants, since the pathologies of the same name they cause are recorded in several or all of the plants (Levitin, Tyuterev, 2003; Din, Van Kan, Pretorius, 2012).

The fungi recorded during the research caused various pathologies in plants. Species belonging to the genera *Alternaria, Ascochyta, Botrytis, Fusarium, Phoma, Puccina, Septoria, Urocystis, Uromyces, Verticellium*, etc. caused mold, rust, wilting, black and brown spots, rot, powdery mildew, etc. in plants, causing serious changes in both their morphological and biochemical indicators. Many of the mentioned fungi have the ability to synthesize biologically active substances such as phytohormones or mycotoxins as secondary metabolites as a result of their life activities (Li, Gu, Wu, 2017; Methods of Experimental Mycology / Under ed. Bilay, 1982).

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Fungi can affect physiological processes in plants in a variety of ways. These effects include both negative effects that weaken plant health and positive effects that support growth and development. Negative effects can manifest in the form of parasitism, mycotoxin secretion, infection, and spread. For example, parasitic fungi such as *Alternaria, Erysiphe, Puccinia, and Phytophthora* damage plant tissues by causing diseases such as powdery mildew, rust, and root rot, respectively, and cover the leaf surface by causing necrosis and spots on the leaves, destroying tissues, and thus reducing the photosynthetic capacity of the plant. At the same time, it limits the supply of oxygen to the plant and weakens energy production (Marin-Menguiano, Morenosanchez, Barrales, 2019). Fungi of the genus *Fusarium and Phytophthora* damage plant roots, impairing water absorption by the roots, disrupting the water balance and causing wilting. Some fungi also disrupt the hormonal balance in plants by secreting hormones and toxins. The hormone gibberellin, produced by the fungus *Gibberella*, causes abnormal growth of plant tissues. Toxins produced by fungi of the *Alternaria* genus increase the amount of abscisic acid, leading to premature leaf drop. Aspergillus species secrete a variety of mycotoxins, including aflatoxins, ochratoxins, and sterigmatocystin, which cause oxidative stress in leaves, damaging the structure of chloroplasts, and inhibiting electron transfer in Photosystem II (PSII), which reduces the conversion of light energy to chemical energy. This process is observed by the oxidation and inactivation of proteins, especially in PSII (Dance, 2017). Aspergillus toxins direct plant resources to defense mechanisms. This reduces the energy and nutrients available for photosynthesis and other metabolic processes (Muradov, Shirinova, Asgerli, 2019).

Conclusion

The positive effects of fungi on plant organisms have also been widely studied. Mycorrhizal and symbiotic fungi stimulate the absorption of nitrogen, phosphorus, water, and other minerals in the soil by plant roots. Beneficial fungi stimulate the production of plant hormones (auxin, cytokinin), which accelerate the growth of roots and shoots. They also decompose dead plant and animal remains, enriching the soil with nutrients that can be absorbed by plants. Fungi also participate in the fight against harmful microorganisms. For example, fungi of the genus *Trichoderma* protect plant roots from harmful bacteria. Fungi such as *Trichoderma* make plants more resistant to biotic and abiotic stresses. They protect plant cells from harmful effects by activating antioxidant defense mechanisms.

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Investigation of the Role of Gibberellic Acid in Salinity Tolerance of Upland Cotton Plant

Abstract

The salinity is the actual issue in the plant growth. It directly restricts the productivity of plants in the whole species. Using phytohormone(s) in seed priming is one of the most crucial treatment methods to protect plants from salinity.

A plant hormone called gibberellic acid (GA_3) is essential for controlling plant growth and development, especially in stressful situations. Determining the potential of seed priming with gibberellic acid under salt stress was the main goal of our study. We investigated the effects of varying GA_3 and NaCl concentrations on the levels of chlorophyll a, b, and carotenoids in cotton seedlings of the *Gossypium hirsutum* L. Agdash-3 genotype. This study also showed the effects of different GA_3 concentrations on the dynamics of polyphenol oxidase activity, which is crucial for the metabolism of phenolic substances and their involvement in plants' defense response. This investigation demonstrates that gibberellic acid regulates antioxidant enzyme activity and sustains chlorophyll a, b and carotenoid contents during salt stress circumstances which enhances resistance to salinity in cotton plants.

Keywords: *Salinity, Gibberellic acid (GA_3), Gossypium hirsutum, antioxidant enzymes*

Introduction

It is important to note that soil salinity is the biggest problem in agricultural development and this issue can affect negatively future generations. It restricts crop productivity and sustainability. Having a high salt content in the soil limits water uptake and leads to oxidative stresses and ion toxicity (Abdel-Hamid *et al*., 2014). Damaging membranes and reducing photosynthetic rate can occur due to salt-affected soil which makes stressful conditions for the plants. To detect and struggle with adverse effects, plants have been adapted to some morphological and physiological changes like getting a formation of relevant solutes to protect cell content, improved water utilization efficiency, and ROS detoxcification involving activating anti-oxidant systems (Augé et al., 2014)

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One of the most significant fiber crops in the world, cotton (Gossypium spp.) provides millions of farmers with a living and is an essential raw ingredient for the textile industry.
India, China, the United States, Brazil, and Pakistan are among the largest producers, with around 35 million hectares under cultivation in more than 80 nations. Over $50 billion is produced worldwide each year by the cotton business, which makes a substantial contribution to both industrial and rural economies.

Research

Cotton is important for sustainable agriculture in addition to its economic value. In contrast to many other primary crops, it resists drought and yields items like livestock feed and cottonseed oil, which increases its agricultural importance. Cotton is still extremely susceptible to salt stress though, which risks results and fiber quality in arid and semi-arid areas despite its ability to survive (Jenkins et al., 2018; Mammadova et al., 2024).

Soil salinity is one of the most significant abiotic elements influencing cotton production, especially in areas with extensive irrigation. The formation of too much salt, mostly sodium chloride (NaCl), in the soil, causes salinity stress, which impairs plants' ability to absorb water and maintain nutritional balance (Munns, Tester, 2008; Alizada et al., 2024). Normally, cotton is known as a tolerant plant in contrast to other crops. Despite having some biochemical alterations in the cotton against harmful effects, at the high salinity conditions, it can cause of reduction in production and fiber quality. Osmotic stress is one of the direct consequences of salinity on cotton plants, where a high concentration of salt in the soil impairs the plant's capacity to take in water Because excessive salt levels cause problems with seeds' ability to absorb water, they also negatively impact seed germination and the beginnings of seedlings (Sharif, *et al*., 2019).

Understanding how plants interpret stress signals and react to different environmental stressors is crucial. Endogenously generated chemical compounds known as phytohormones play an essential role in controlling the growth and production of plants. There are several phytohormones such as gibberellins, ethylene, abscisic acid (ABA), and jasmonic acid (JA) which are necessary in stimulating plants to become more resistant to different types of stress (Khan, N. et al., 2020).

Gibberellic acid's (GA_3) capacity as a basic plant hormone has been shown in several studies. Gibberellins (GAs), are essential for the germination of seeds and seedling development, stem and the length of the root, growing leaves and flowering. Because they control a variety of metabolic processes, the activity of multiple enzymes, and gene regulation (Miceli, A. et.al., 2019). Exogenous GA_3 treatment improves ion adoption, photosynthetic activity, effectiveness of water use, stomatal activity, and other phytohormone balance (Alonso-Ramírez et al., 2009). GA_3 also reduces lipid peroxidation and increases the effectiveness of antioxidants and osmoprotectants to mitigate the severe impacts of stress factors (Rady, et al., 2021.)

Several studies have demonstrated a relationship between GAs and JAs in both favorable and unfavorable circumstances. According to Achard *et al*. (2008) DELLA proteins build up whereas GA signaling decreases in response to cold stress, reducing plant development. According to Wingler et al. DELLA proteins can attach to JAZ proteins, which stimulates jasmonate-responsive genes. JA–GA interaction under extreme conditions is revealed by this result. Their stimulating and inhibitory properties in plants are similar to those of other plant hormones, and their antagonistic or synergistic effects with regard to other crop hormones are well documented (Soto, A. et al., 2012).

The goal of this study was to find out how gibberellic acid helps cotton plants become more tolerant of salinity. Our study tried to shed light on the possible use of GA_3 as a tactic for reducing salinity stress in cotton farming by assessing its effects on growth, physiological indicators, and stress-related reactions (Wingler, Tijero, Müller, Yuan, Munné-Bosch, 2020).

Material and Methods

The upland cotton- *Gossypium hirsutum* Agdash-3 genotype, which was obtained from the Genetic Resources Institute of the Ministry of Science and Education, Republic of Azerbaijan, was used for the tests. Cotton genotype seeds were placed in 7 cm plastic cups filled with perlite after being pre-treated for eight minutes with 0.2% potassium permanganate. In a growth chamber, the

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seedlings were cultivated at 22–24°C, 65–75% humidity, and 4800 lux of light. The duration of the lighting was 12/12 hours, day and night. Throughout the whole growth period, beginning with the initial days of seedling formation, Steiner's solution was utilized as a nutritional medium with the addition of 150 ppm and 300 ppm of GA_3. Analysis was done on embryonic cotyledons that were three weeks mature. We also used a mixture of GA_3 and NaCl (8.7 g of salt per 1 liter in each stage) in the first, second, and third stages to measure how these components affect plant growth (Ahmad, Kamal, Singh, Ashfaque, Alamri, Siddiqui, Khan, 2021).

Catalase activity-The Mosheva gasometric approach was used to measure catalase activity (Mosheva, 1982). After measuring half a gram of plant product, 20 ml of purified water and 0.5 g of $CaCO_3$ were gradually added to homogenize the mixture. Catalase activity was then tested when the extract was moved to an Erlenmeyer flask, a Landolt vessel with a side neck. Five milliliters of 3% were added to the extract to initiate the reaction, and a magnetic stirrer was used to mix it continuously. After two minutes, the measurement was completed. Following this period, the burette scale san be used to read the amount of oxygen emitted. The pure sample's enzyme activity was measured in milliliters per second*g (Amrahov, Mammadova, Allahverdiyeva, Aliyev, Alizada, Aghazada, Ojagverdiyeva, Mammadov, 2023).

Peroxidase activity-In reference to Chance and Maehly (Chance & Maehly, 1955), peroxidase activity was measured. In an ending amount of 4 ml, the reaction mixture contained 500µl of enzyme extract, 0.1 M Na-phosphate buffer, pH 7,2, 1 mM EDTA, 30 mM H2O2, and 50 mM guaiacol. At 440 nm, tetraguaiacol production was observed. The extinction value of tetraguaiacol (26.6mM −1 * cm−1) was used to determine the concentration of the compound. The expression for POD activity was $\Delta A590 * g^{-1} * min^{-1}$.

Polyphenol oxidase activity-Polyphenol oxidase activity was measured by tracking the oxidation of a 0.05 M catechol solution at 590 nm. The reaction took place in a 0.1 M potassium phosphate buffer at pH 7.2, following the method described by Yermakov et al. (1987). The enzyme activity was expressed in units per minute per gram of fresh weight (U/min*g FW).

Chlorophyll a, b, and carotenoids-The Wellburn method was used to determine the levels of carotenoids, chlorophyll a, and b (Wellburn and Lichtenthaler, 1984). In a mortar, 20 milliliters of 80% acetone were mixed with one gram of freshly cut leaf tissue that had been sliced into tiny pieces. A filter paper of F grade was next applied to filter the homogenate. The resultant filtrate's optical density was measured at 440, 644, and 662 nm. The results were measured in mg/g of fresh material (Wellburn, Lichtenthaler, 1984).

Results

Under various conditions, such as salt stress (150 mM NaCl), and gibberellic acid (GA) administrations (150 ppm and 300 ppm), the catalase activity (ml/sec*g) is illustrated in this bar chart. Furthermore, it shows the relationship between GA and salt stress to comprehend the possible moderating effects of GA on the catalase activity of the Agdash-3 genotype. (Fig 1)

Treatment with 150 mM NaCl significantly reduces the catalase activity, which is 40% lower than the control. In contrast, treatment with 150 ppm GA_3 increases catalase activity to around 85% of the control phase, which is greater than salt-stressed plants but a few less than the control. Though not as noticeable as with 150 ppm GA_3, 300 ppm GA_3 shows a small increase in activity and approaching 75% of the control level when comparing with plants during NaCl stress. Consequently, 150 ppm GA_3 restores enzyme activity at its peak and successfully opposes the negative effects of stress caused by NaCl. In terms of lowering salt stress, this last condition suggests that 150 ppm GA_3 is more advantageous than 300 ppm GA_3 since it results in a greater recovery in catalase function ninety percent of control in comparison to the 300 ppm GA_3 phase (Fig 1) (Al-Harthi, Bafeel, El-Zohri, 2021).

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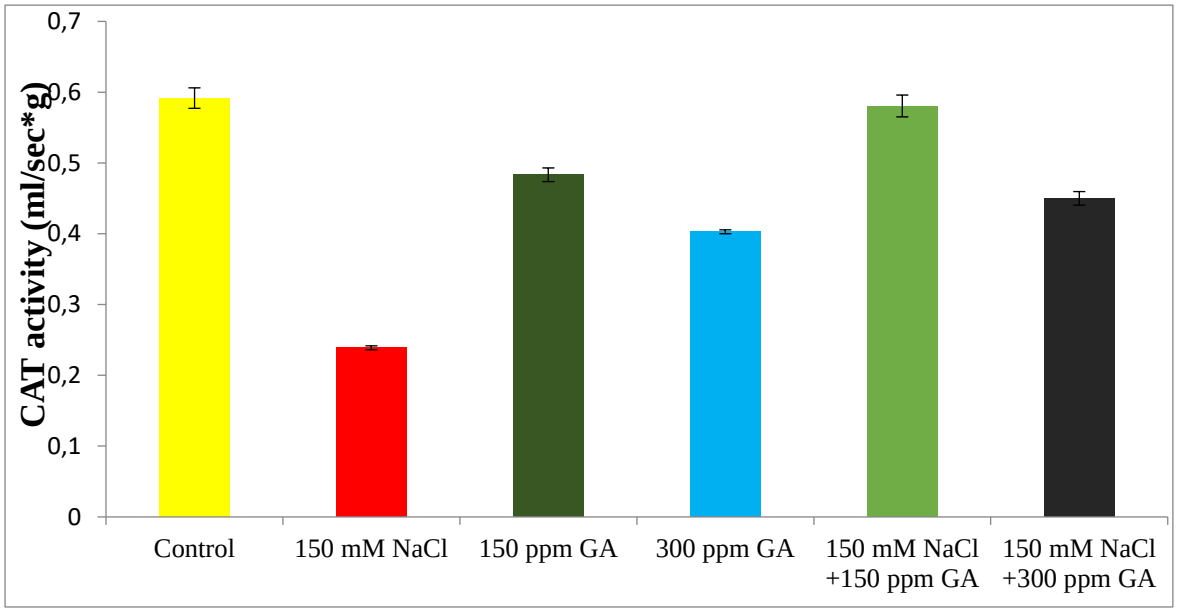

Fig 1. Catalase (CAT) activity in Agdash-3 genotype exposed to various concentrations of GA and NaCl

This bar chart exhibits peroxidase activity for several conditions. By converting hydrogen peroxide (H_2O_2) into oxygen and water, peroxidase, called POX, an essential defense enzyme, aids plants in coping with damage caused by oxidative stress. (Fig 2)

150 mM NaCl significantly lowers the lowest level of activity of peroxidase in every approach (50–60% drop compared to control). At 150 mM NaCl, peroxidase activity significantly decreases (by roughly 50%). However, the 150 ppm GA_3 dosage significantly increases peroxidase activity (by around 20-30%) in comparison to the salt-stressed category. Peroxidase activity dramatically increased in the 150 mM NaCl + 300 ppm GA_3 method comparison with all other procedures, surpassing the control by 10 to 20 percent. This indicates that the maximum stimulation of peroxidase activity occurs at a higher GA_3 level (300 ppm GA_3) under saline circumstances (Achard, Gong, Cheminant, Alioua, Hedden, Genschik, 2008). (Fig 2)

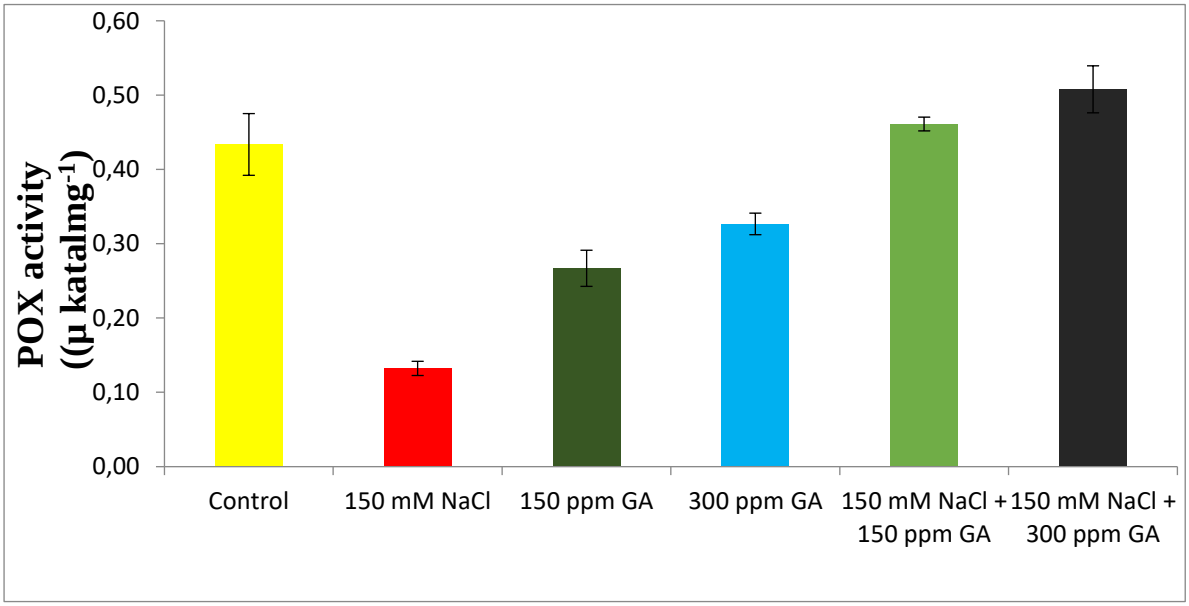

Fig 2. Peroxidase (POX) activity in the Gossypium hirsutum Agdash-3 genotype faced with varying levels of GA and NaCl

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This bar graph displays the activity of polyphenol oxidase (PPO). PPO is a specific enzyme that is essential to plant defense systems, especially when plants are under stress. It does this by accelerating the conversion of polyphenols to quinones, that can protect plants from infections and oxidative stress. (Fig 3) (Misratia, Ismail, Hakim, Musa, Puteh, 2013).

Among of each of the treatments, 150 mM NaCl (red bar) exhibits the largest increase in PPO activity, rising by almost 25% in comparison to the control. This means a salt unbalance stimulates an effective PPO reaction by increasing the stress response and engaging the protective mechanism. With 150 ppm GA_3, polyphenol oxidase (PPO) activity clearly drops about fifteen percent, but with 300 ppm GA_3, it increases by roughly 10%, reaching levels that are nearly identical to the control. In comparison to 150 mM NaCl alone, PPO activity falls by eight to twelve percent in the final two treatments, 150 mM NaCl + 150 ppm GA_3 and 150 mM NaCl + 300 ppm GA_3. This suggests that GA_3 supports in controlling PPO activity during salt stress, avoiding over-activation while preserving the plant's defensive reaction. (Fig 3) (Chance, Maehly, 1955).

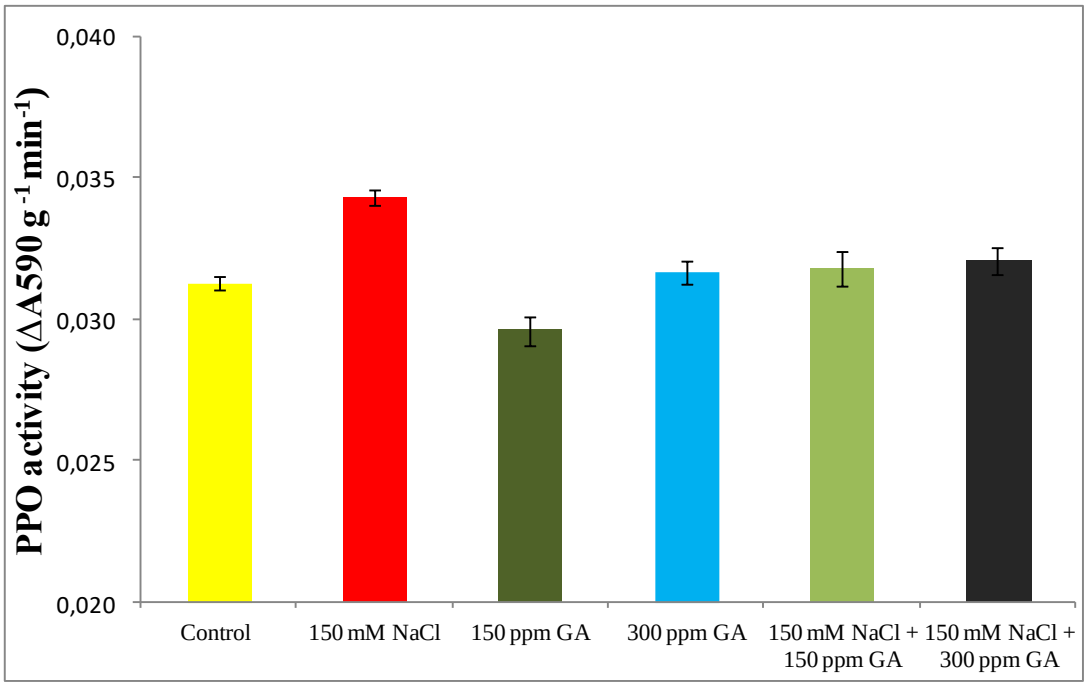

Fig 3. The activity of polyphenol oxidase (PPO) of Gossypium hirsutum Agdash-3 genotype exposed to different concentrations of GA and NaCl

The amounts of carotenoids, chlorophyll a, and chlorophyll b (in µg/ml) under various conditions have been shown in this graph. (Fig 4)

In contrast to chlorophyll b and carotenoids, the chlorophyll a level in this figure demonstrated a strong favorable influence of GA_3 and NaCl. Chlorophyll a levels declined by roughly 22 percent during 150 mM NaCl stress in comparison to the control. However, as in comparison with NaCl stress alone, the amount of chlorophyll raised by 18% when 150 ppm GA_3 was added, and by 28% when 300 ppm GA_3 was added. Under all circumstances, levels of carotenoid and chlorophyll b stayed largely constant, with very slight variations of between five and ten. Approximately 30% of the pigment was lost overall due to salt stress, however up to 40% of the missing pigment was recovered with the use of 300 ppm GA_3. Nevertheless, the combination of high GA_3 and NaCl stress further decreased pigment content, most likely as a result of overstress. (Fig 4)

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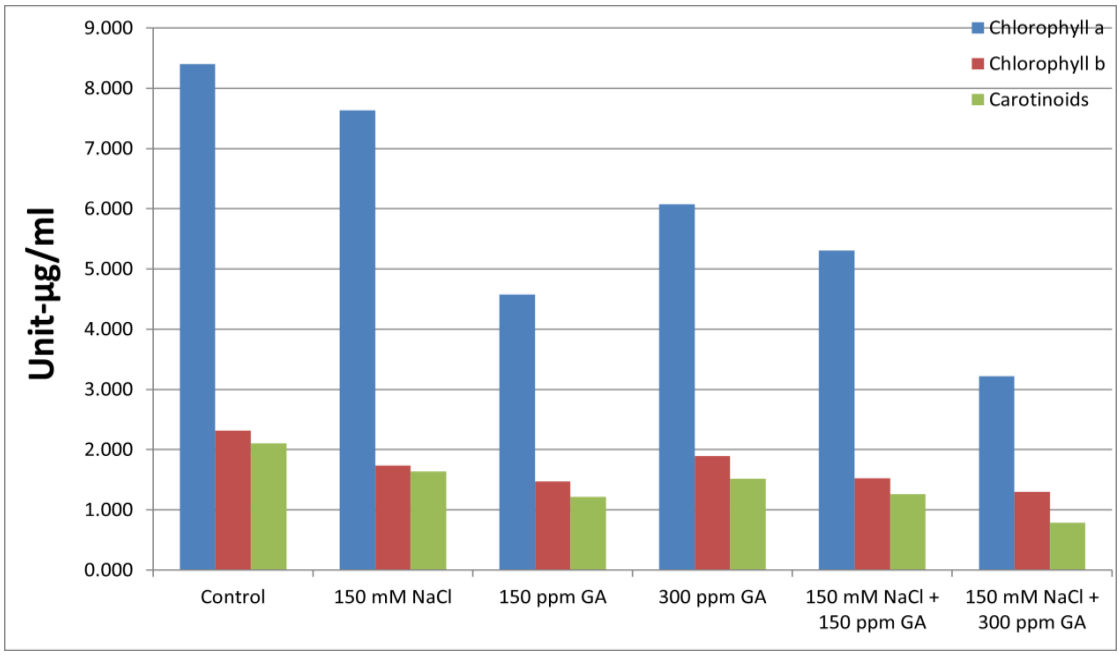

Fig 4. The impact of varying GA and NaCl concentrations on the levels of carotenoids, chlorophyll a, and b in the Gossypium hirsutum Agdash-3 genotype.

Investigating the impact of 150 mM (NaCl) and 150,300 ppm (GA_3) concentrations of GA_3+NaCl on the morphological characteristics and antioxidant enzymes of cotton plants was the goal of this research. We aimed to find out how these substances affect plant development and antioxidant enzyme activity.

Following phytohormone therapy, analyses were conducted to measure the length of the roots and shoots as well as the activity of the enzymes.

Fig.5. Impact of NaCl and NaCl+GA_3 on the development of AP-317 cotton genotype.
Table 1. Root and shoot length of the AP-317 genotype.

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Treatment	Root Length (Mean ± SD)	Shoot Length (Mean ± SD)
Control	12.617 ± 1.66	29.711 ± 2.62
150 mM NaCl	8.815 ± 0.90	14.353 ± 0.22
150 ppm GA	8.708 ± 1.30	35.764 ± 0.83
300 ppm GA	4.946 ± 0.60	29.255 ± 3.22
150 mM NaCl + 150 ppm GA	6.731 ± 1.15	18.049 ± 0.34
150 mM NaCl + 300 ppm GA	5.612 ± 0.24	13.799 ± 1.28

This table shows that plant growth had been affected by salt stress, which reduced root length and substantially inhibited shoot elongation. This demonstrates how salt inhibits the growth of plants. Shoot length dramatically rose at 150 ppm GA_3, greater than especially the control group. But like the NaCl treatment, the root length decreased. According to the concentration of 300 ppm, too much GA_3 promotes shoot growth but inhibits root elongation. In the treatment of GA_3 (150ppm) with NaCl (150 mM) showed that GA_3 did not mitigate root growth inhibition and obviously salt-stressed plants were not improved by high GA_3 (300 ppm) concentrations. (table 1) (Mosheva, 1982).

Discussion

Our consequences showed that gibberellic acid (GA_3) modulates enzymatic antioxidant activity and preserves chlorophyll and carotenoid levels under salt stress scenarios, which enhances the salinity tolerant of cotton Agdash-3 genotype. The results are consistent with other research that highlights the role of plant hormones in reducing the negative impacts from stress and maintaining development across salty conditions (Rady et al., 2021).

The differential effect of GA_3 on the antioxidant enzyme function was one of the main conclusions. When compared with plants exposed to NaCl stress solely, the introduction of GA_3, especially at 150 ppm, resulted in an important restoration in catalase and when 300 ppm GA_3 (with NaCl) was added, peroxidase activity increases while catalase activity decreases, suggesting that peroxidase carries the majority of the 300 ppm GA_3 concentration's load. (Fig 1 and 2). Furthermore, 150 ppm GA_3 restored catalase activity better than 300 ppm, demonstrating that there is an ideal concentration at which GA_3 management would not provide any more advantages. Miceli et al. (2019), who documented a comparable pattern in other crop varieties, support these findings (Yermakov, Arasimov, Yarosh, 1987).

PPO activity responded differently, with the maximum enzyme activity being induced by NaCl treatment independently (Fig 3). If PPO activity decreases, this indicates that GA_3 does not significantly affect PPO. An increase in PPO activity under salinity conditions indicates an increase in quenols. However, treatment with GA_3 stabilizes this amount (Fig 3). According to Yermakov et al. (1987), PPO's function in stress reduction and protection against oxidative damage is consistent with its increased activity under salt stress. The decrease in PPO activity following GA_3 therapy, however, raises the possibility that gibberellic acid controls PPO levels to avoid increased oxidation and preserve cellular homeostasis. Other research that focused on hormone-mediated stress adaptation in plants are consistent with GA_3's capacity to control PPO activity without over-activating it (Sharif et al., 2019).

Conclusion

The study also discovered that using GA_3 considerably reduced the decrease in chlorophyll a level based on salt stress (Fig 4). Although levels of carotenoid and chlorophyll b were mostly constant during treatments, GA_3 treatments particularly at 300 ppm helped to partially restore the amount of chlorophyll a (Fig 4). According to this finding, GA_3 could help to preserve photosynthetic efficiency under challenging circumstances by maintaining chlorophyll-protein

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complexes and lowering oxidative stress (Wellburn & Lichtenthaler, 1984). Nevertheless, overstimulation and elevated demands on the metabolism caused another drop in pigment level as a result of excessive GA_3 treatment, especially when linked with NaCl (Fig 4).

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Comparative Analysis of Sugar Beet Cultivation Using Conventional Loosening and Strip Till Technology

Abstract

In the context of the intensification of agriculture, the choice of the optimal technology for growing sugar beet, which ensures an increase in yield and profitability of production, is particular relevance. In the Yevlakh region of Azerbaijan, where climatic conditions are characterized by dry periods and soil heterogeneity, it is important to conduct a comparative analysis of traditional and strip tillage technologies.

Traditional technology includes plowing, harrowing, and cultivation, which helps improve soil aeration and texture. However, this treatment system leads to moisture loss, destruction of the humus layer, and increased fuel and labor costs. In contrast, strip till allows you to cultivate only narrow strips of soil, preserving its natural structure and reducing erosion processes.

The analysis showed that the use of strip till technology helps to increase the moisture retention capacity of the soil, reduce resource consumption and increase plant resistance to drought. This makes this technology promising for implementation in the conditions of the Yevlakh district, ensuring the environmental and economic efficiency of sugar beet production.

Keywords: *sugar beet, strip till, traditional technology, yield, soil moisture, economic efficiency, Yevlakh district*

Introduction

Sugar beet is an important technical crop that requires optimal conditions for root crop formation. One of the main factors influencing the quantity and quality of the crop is the method of tillage. This article discusses two methods:

Conventional loosening (traditional processing)

Strip-till technology

Let's consider their effectiveness using the example of the Yevlakh region, Azerbaijan, taking into account soil and climatic conditions.

Soil and climatic conditions of the Yevlakh district.

The Yevlakh district is located in the Central part of Azerbaijan and is characterized by a moderately dry subtropical climate.

Soil types: gray-earth, meadow-gray-earth, and alluvial-meadow soils.

Average annual precipitation: 350-400 mm.

Precipitation during the sugar beet growing season (April–September): 150-180 mm.

The sum of active temperatures during the growing season (above +10°C): 3400-3600°C.

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Features of the region: hot and dry summers, which makes water conservation a critical factor in the cultivation of sugar beet.

Description of tillage methods

The usual loosening:

Research

It includes plowing to a depth of 20-30 cm, subsequent cultivation and harrowing.

The soil is completely turned over, which facilitates the development of the root system.

It allows effective weed control.

Strip till technology:

Strip loosening of soil 20-30 cm wide while maintaining untreated row spacing.

Combines tillage, fertilization and sometimes sowing in one pass.

It preserves plant residues on the field surface, reducing erosion and moisture evaporation.

Influence of cultivation methods on soil properties (under Yevlakh conditions).

Indicator	The usual loosening	Strip-till technology
Soil structure	Loosens quickly, but may be over-compacted below the plowing area	The structure of the top layer is preserved, and compaction is minimized
Moisture content	Rapid loss of moisture, especially in the upper layers	Reduction of moisture evaporation due to plant residues
Soil temperature	Quick warm-up in spring	Slower heating due to plant residues
Microbiological activity	Less organic matter, high mineralization	High biological activity, less erosion

Influence on the growth and development of sugar beet

Advantages of Conventional (traditional) loosening:

Rapid seed germination due to good soil contact.

There may be problems with over-compaction at a depth of 30-35 cm, which limits the development of the root crop (Doroshenko, 2018).

In Yevlakh conditions, during a dry summer, there is a risk of reduced yields due to moisture loss.

Advantages of Strip-till technology:

More uniform distribution of moisture.

Reduced risk of erosion and weathering.

Deep development of the root system due to the absence of a compacted layer.

Slow warming of the soil in spring can slow down the initial development, which is important to take into account in the conditions of the region.

Strip-till technology has been around for over 15 years. This technology is widespread in European countries, the United States of America, Canada and Azerbaijan. According to this technology, corn, soybeans, sugar beet, cotton, sunflower, potatoes, tomatoes, cabbage and many other vegetable crops are grown in the world. In Azerbaijan, crops such as corn, soybeans, and sugar beet are grown with this technology. To date, the greatest practical experience in using Strip-till (strip tillage) has been accumulated by American farmers, who were the first to see the high efficiency of this technology (FAO, 2022). For this reason, over the past 11-12 years, many farms in the so-called "corn belt" of the United States have switched to this technology, and about 17 companies in the country have organized the manufacture of equipment for Strip-till technology. Strip-till literally means "strip tillage". This technology occupies a place between classical (conventional) and zero tillage, that is, No-till. With strip tillage, the field is cultivated only in strips and sown with agricultural crops. Each row, plowed by devices for strip tillage, is about 20-25 cm wide (Gordeev, 2018). The rest of the area remains uncul-

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tivated, i.e. covered with stubble (remnants) of the previous crop. Strip-till is a system of economic use of nature, in which minimal tillage occurs. It combines the advantages of conventional tillage, such as drying the soil and warming it up. This type of processing is performed using special equipment - a Striptill cultivator. In addition to the described advantages of strip tillage, Strip-till has the advantage of conventional tillage in that an agronomist can apply chemical protection agents and mineral fertilizers simultaneously with tillage or sowing (Gumenyuk, 2017).

Due to global warming, the technology of strip tillage can be considered one of the most productive in the modern world. Since, according to the data of practical use, this technology is successfully successful both in drought and in high humidity conditions. When using this technology, only loosening of the strip in which the seeds of cultivated plants are sown is performed, and about two thirds of the field remains untreated. In this way, the soil retains its structure. With strip loosening, tillage consists of only two work operations, which are performed depending on the season (Ivanov, 2021):

Loosening in autumn or spring, then sowing in loosened strips. In Azerbaijan, the practice of using strip tillage shows that agricultural producers using Strip till technology have more opportunities to obtain high yields, as the crop is in optimal conditions during the growing season and becomes more resistant to adverse environmental conditions. Azerbaijani agronomists can save on fuel when preparing the soil for sowing, achieve lower labor costs and fertilizers. Also, save on the number of repairs and operation of the tractor, and reduce general household expenses. This is one of the most important conditions for a farmer, given the income from the harvest with the least labor and money (Kiryushin, 2015).

We can give an example of the use of band-pass technology in Russia. Practice shows that the technology has produced excellent results in the cultivation of row crops. Especially corn and sunflower seeds.

In Azerbaijan, the Azersugar farm operates in the Yevlakh region using this technology. In recent years, production experiments have been conducted on growing corn and sugar beet using Strip-till technology. The resulting yield turned out to be 30-40% higher than on the site using traditional technology. The farm also found that 240 kg of ammophos is sufficient for corn cultivation in the strip treatment system when applied in autumn, and 150 kg/ha for sugar beet (calculations were carried out at the request of the soil after the results of agrochemical soil analysis) (Konovalov, 2016). When using traditional technology and continuous fertilization, farms usually used twice the norm (450 and 300 kg/ha of ammonium). The average yield of corn for grain using No-till technology is 80 kg/ha, and on a Strip-till plot it is 100-120, and the yield for sugar beet is 600 and 900 kg/ha. In the near future, the farm plans to cultivate other crops using Strip-till technology (Klimov, 2019).

Traditional tillage.

This treatment includes several techniques depending on the time:

Main processing (winter plowing)

Spring processing

Pre-sowing treatment

In the system of agrotechnical measures that contribute to further increasing the yield of agricultural crops and improving its quality, winter plowing is of great importance. The soil that has been plowed since autumn is exposed to various degrees of climatic factors during the cold season, such as precipitation, wind, freezing and thawing. With this effect, the soil surface becomes finely lumpy. Chafing is especially effective in soils with a gley horizon. Also, timely winter plowing is a mandatory measure in the fight against clogging of fields, which provides favorable conditions for spring and pre-sowing preparation of arable land for sowing, obtaining friendly seedlings, good development and high yield with early ripening (Miller, 2020).

Finch plowing provides high efficiency if carried out at a favorable time, which is mainly in the period from October 25 to December 10-15, and in the southern regions it is possible later. If for some reason it was not possible to produce the winter plowing according to the specified dates, then this procedure can be postponed to the prudent days of January, February and March. At this time of the year, tillage will have the same effect than if you leave the tillage on the eve of sowing (Romanov, 2019).

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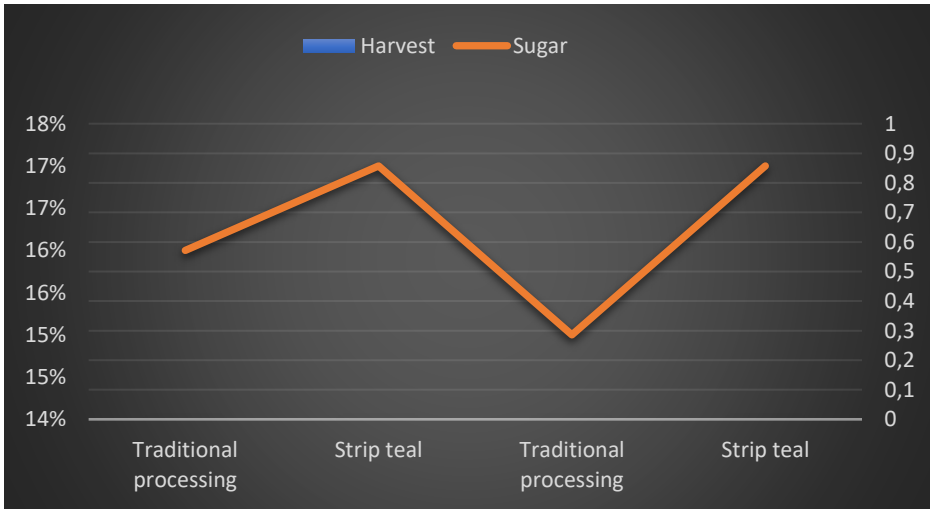
In our article, we want to show the effectiveness of these technologies in sugar beet cultivation. But it must be taken into account that sugar beet does not allow late tilling of the soil and it is impossible to perform deep plowing in the spring, taking into account also the conditions of the region. Therefore, it is necessary to limit ourselves to the exact time and execution of winter plowing in the autumn period. At the same time, 70% of the mineral doses of phosphorus and potassium should be applied during this period, calculated from 100% of the percentage for the entire growing season.

Spring processing for sugar beet involves closing moisture when the soil is physically ripe. This operation is performed by combined units in one pass. Such treatment ensures the creation of a loose lumpy soil structure with a content of at least 85% of lumps up to 10 mm in size in the loosened layer and a soil density of 1.0 – 1.3 g/cm3. Lump sizes of more than 30 mm should not be allowed (Smith, 2021).

Pre-sowing tillage is aimed at leveling the soil surface, preserving moisture in it that has accumulated in the autumn, winter, and spring periods, and destroying weeds that begin to germinate by this time. Pre-sowing treatment creates conditions for sowing seeds, sealing herbicides, fertilizers, which leads to the provision of friendly and full-fledged shoots of sugar beet.

For soils subject to wind or water erosion, a soil protection technology is recommended, which provides for non-destructive loosening of the soil to a depth of 20-22 cm, leaving mulch on the surface of the field (Zhou, 2020).

Sugar beet yield and product quality indicators (sugar content, %)



Indicator	The usual loosening	Strip-till technology
Average yield	45-55 t/ha	60-90 t/ha
Sugar content	15–16%	16–17%
Cost price	Higher due to the higher number of operations	Lower by reducing processing
Maturation dates	A little shorter	It can be elongated

Traditional loosening

Strip-till Technology

With traditional loosening, the following strategies should be followed: use deep freezers (destruction of the compacted layer), ensure timely irrigation to compensate for moisture loss (below 150-180 mm during the growing season), and use balanced fertilizers containing trace elements.

When Strip-till is processed, it is necessary to optimize the sowing time, use drip irrigation systems (in our experiment, sprinkling irrigation) to maintain uniform humidity, and apply fertilizers locally to the sowing strip.

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Conclusions

Strip-till technology shows the best results in yield and quality of sugar beet in the conditions of Yevlakh due to the preservation of moisture and soil structure.

Conventional loosening remains effective with good irrigation, but requires high costs.

In conditions of low precipitation and high active temperatures, strip-till technology ensures more sustainable and economically profitable sugar beet production.

Result:

For the Yevlakh region, Azerbaijan, strip till technology is promising solution that allows efficient use of available water resources and consistently high yields.

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Forecasting the Potential of Hybrid Combinations and the Manifestation of Quantitative Traits

Abstract

The topic is a crucial area in genetic research and agricultural breeding. It explores the potential of hybrid combinations and how quantitative traits, which are influenced by multiple genes, manifest in organisms. In summary, this topic focuses on the genetic diversity, hybridization, and the inheritance of quantitative traits (such as yield, growth rate, and resistance to diseases). Hybrids are created by combining different genetic backgrounds, and this process is essential in agriculture to achieve better performance and desired traits.

Keywords: *hybrid combinations, potential, quantitative traits, forecasting, manifestation*

Introduction

Hybridization in plants and animals is a vital tool in improving desirable traits and increasing yield in agricultural and breeding programs. The potential of hybrid combinations and the manifestation of quantitative traits play a crucial role in predicting the success and effectiveness of such breeding programs. Quantitative traits, such as yield, size, and resistance to diseases, are controlled by multiple genes and their interaction with environmental factors. Understanding how these traits manifest in hybrids and forecasting their potential is key to improving genetic outcomes. Hybrid combinations involve crossing different genetic lines to combine desirable characteristics from both parents (Falconer, Mackay, 1996). These combinations can enhance specific traits such as disease resistance, drought tolerance, or improved nutritional content. The potential of these hybrid combinations depends on several factors. The ability of two genetically distinct lines to combine and complement each other's traits, the phenomenon where hybrids outperform both parent lines in terms of growth, yield, or other traits, the greater the genetic distance between the parent lines, the higher the chances of creating hybrids with superior characteristics, the ability of hybrids to adapt to different environmental conditions, which is essential for their performance in various locations (Bernardo, 2002).

Research

Quantitative traits are characteristics that vary in degree and are influenced by multiple genes (polygenic traits). Unlike qualitative traits (such as flower color or seed shape), which are controlled by one or a few genes, quantitative traits require a broader genetic approach for improvement. Examples of quantitative traits include: The amount of crop produced per unit area, plant height or animal size, the plant's or animal's ability to resist pathogens, speed at which an organism grows (Zhang, Zhang, 2016).

The manifestation of these traits in hybrid combinations depends on how the genetic factors interact with each other and the environment. Forecasting the expression of quantitative traits in hybrid offspring requires detailed knowledge of the genetic make-up of the parents and their environmental interactions (Wright, 1931).

Forecasting the manifestation of quantitative traits in hybrid combinations involves several strategies, including (Xu, 2013):

1. Statistical Models: Statistical tools such as quantitative trait loci (QTL) mapping and genome-wide association studies (GWAS) are used to identify the genetic regions that influence

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quantitative traits. By analyzing the parent lines and the hybrid offspring, breeders can predict how traits will be inherited and expressed in future generations.

2. Genomic Selection: Genomic selection involves using DNA markers to predict the performance of hybrids before they are even grown. This allows for more accurate forecasting of quantitative traits in hybrid offspring.

3. Field Trials: Growing hybrids in diverse environmental conditions provides empirical data on how quantitative traits manifest. This data can be used to refine predictions and improve the accuracy of forecasting models.

4. Bioinformatics: Advances in computational biology and bioinformatics help model how different genes interact to express quantitative traits, providing valuable insights into potential outcomes of hybrid combinations.

While hybrid combinations offer significant potential, forecasting their success can be challenging. Some of the challenges include guantitative traits are highly influenced by environmental factors, making it difficult to predict outcomes with complete accuracy. Factors such as soil quality, water availability, temperature, and pests can alter the expression of traits (Heslot, Crossa, 2014). The interaction between multiple genes and their alleles can result in complex trait inheritance patterns. This makes it harder to predict the manifestation of quantitative traits in hybrid offspring. The interaction between different genes may sometimes have a non-additive effect on traits, leading to unexpected outcomes in hybrid offspring (Lush, 1945).

In modern plant and animal breeding, hybridization plays a crucial role in enhancing specific traits such as disease resistance, yield, and adaptability to various environmental conditions. One of the key aspects of successful breeding programs is the ability to forecast the potential of hybrid combinations and the manifestation of quantitative traits. These traits, such as growth rate, yield, and resistance to stress, are typically controlled by multiple genes and are influenced by environmental factors. Forecasting how these traits will manifest in hybrid offspring is vital to predicting the success of breeding strategies and improving the overall genetic potential of crops and livestock (Knapp, Hallauer, 2013).

Forecasting the potential of hybrid combinations and the manifestation of quantitative traits is a fundamental aspect of modern breeding programs. It enables breeders to predict which combinations are most likely to produce favorable outcomes in terms of yield, disease resistance, and other key traits. The integration of genomic technologies, statistical models, and field trials has enhanced the ability to make more accurate forecasts, but challenges remain due to the complex nature of quantitative traits and their interaction with the environment (Spindel, Begum, 2016). As research progresses and new technologies emerge, the ability to forecast hybrid potential and trait manifestation will continue to improve, leading to more efficient and successful breeding programs (VanRaden, O'Connell, 2017).

Hybrid combinations result from the crossing of genetically distinct parental lines. The potential of these hybrids depends on the interaction between the genes of the parent organisms, with the goal of combining the best traits from both sides. Hybrid vigor, or heterosis, is often observed, where the offspring exhibit enhanced traits compared to the parents. However, the full potential of hybrid combinations is not always predictable and depends on several factors (Meuwissen, Goddard, 2001; O'Reilly, McVean, 2016):

1. Genetic Compatibility: The genetic makeup of the parents and how their traits combine and complement each other.
2. Heterosis (Hybrid Vigor): The expression of superior traits such as higher yield or better disease resistance in hybrids compared to both parent lines.
3. Environmental Interaction: The way hybrids interact with environmental factors such as soil type, climate, and moisture conditions. Some hybrids perform better under specific environmental conditions.
4. Genetic Distance: The more genetically distinct the parent lines, the greater the possibility of combining new beneficial traits, though this also increases the complexity of predicting outcomes.

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Conclusion

Forecasting the potential of hybrid combinations and the manifestation of quantitative traits is essential for improving the outcomes of breeding programs. The ability to predict how specific traits will manifest in hybrid offspring allows breeders to focus on promising combinations, ultimately leading to the development of better-performing plants and animals. However, the complexity of genetic interactions and environmental factors means that predictions are not always perfect. Advances in genetics, genomics, and data analysis continue to improve the ability to forecast the manifestation of quantitative traits in hybrid combinations, leading to more efficient and productive breeding practices.

In conclusion, forecasting the potential of hybrid combinations and the manifestation of quantitative traits is crucial for the success of breeding programs aimed at improving specific traits in plants and animals. Hybrid combinations offer the possibility of enhancing desirable characteristics, such as yield, disease resistance, and environmental adaptability. However, predicting the expression of quantitative traits in hybrids remains complex due to the involvement of multiple genes and environmental factors. Advances in statistical models, genomic selection, and bioinformatics have significantly improved the ability to forecast the performance of hybrid combinations and the expression of quantitative traits. These tools enable breeders to make informed decisions, improving the efficiency and effectiveness of breeding efforts.

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The Ustomycetes Class and the Downy Mildew Disease in Plants: Symptoms, Spread and Control Methods 111

Abstract

The class Ustomycetes consists of a group of distinct and significant microorganisms in the fungal world. Fungi belonging to this class can cause smut diseases in various plants. Smut diseases typically manifest with symptoms on plant leaves, flowers, and fruits, and they pose a serious threat to plant health. Ustomycetes fungi spread rapidly, especially in humid and warm conditions, which makes managing these diseases of great importance. This article will discuss the symptoms, transmission pathways, and control methods of smut diseases caused by Ustomycetes fungi in plants.

Keywords: *smut disease in plants, plant health, spread of plant diseases, fungal pathogens, biological infections*

Introduction

The class Ustomycetes is a widely distributed class in the fungal world. Among the members of this class, the genera *Peronosporaceae* (Figure 1) and *Plasmophora* (Figure 2) are particularly notable.

Figure 1

Peronosporaceae is primarily a group belonging to the class Oomycetes, and many of its members cause various diseases in plants. One of the main diseases caused by this class is downy mildew. Numerous members of the *Peronosporaceae* family, particularly species like *Peronospora*, *Plasmopara*, and *Bremia*, are responsible for this disease. Symptoms of the disease include yellowing of plant leaves, dark green or white spots, followed by drying and deformation of the leaves (Cheng, Zhang, Lin, 2020). If left uncontrolled, the disease weakens the plant's growth. It thrives in moist environments, especially during the spring and fall. The spores of Oomycetes

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spread via wind and water. Eventually, fungal infections can also be encountered in affected plants (Agrios, 2005; Chaurasia, Meena, 2021).

Research

Various colored spots (blue, purple) appear on the leaves and stems. Different fungicides are applied to combat diseases caused by *Peronosporaceae*. Infected plants should be cleaned, and proper ventilation should be ensured while avoiding humid conditions. To prevent the spread of the disease, it is important to avoid replanting the same plant species in the same area (Becher, Lenz, 2019; Fischer, Klein, 2018).

There are also diseases caused by the fungus *Plasmopara viticola* in grapevines. White or gray-green spots, typically appearing on the underside of the leaves, are observed on the grapevine leaves. This disease can cause significant damage to grape crops, especially in dry climate conditions. The disease spreads more rapidly in high humidity, particularly during the spring and fall seasons (Muradov, 2009). The spores spread through wind and water. These fungi cause various smut diseases by damaging both the leaves and the roots and stems of plants. Smut fungi are particularly active in plants growing in wet and humid areas, where they have harmful effects on the leaves, stems, and fruits (Muthumeenakshi, Sundararaj, 2015; Ellingboe, Dyer, 2010).

Figure 2

Smut disease typically manifests on the leaves and flowers of plants with distinct symptoms. The main symptoms of this disease are as follows (Pascoe, 2012):

1. **White or yellow spots on the leaves**: White or yellow spots appear on the plant's leaves, especially on young leaves. Over time, these spots grow, reducing the plant's ability to perform photosynthesis.
2. **Leaf deformation and shedding**: Leaves affected by smut disease gradually deform and eventually curl up and fall off.
3. **Poor plant growth**: This disease slows down the overall development of the plant, potentially leading to a loss in yield. Slow growth and poor development further deteriorate the plant's health.
4. **Damage to flowers and fruits**: The fungal infection also affects flowers and fruits. Flowers turn brown or dry up, while fruits rot and are destroyed.

Smut fungi can spread to plants through various pathways. For example, **airborne spread** occurs when smut fungi spread via spores suspended in the air. These spores travel over large areas through wind, rain, and other weather conditions, landing on plants. Another method of spread is waterborne transmission—high humidity and irrigation facilitate the spread of fungi. Water from irrigation or rain carries the fungal spores between plants. Additionally, certain insects, especially aphids (plant lice), can transport fungal spores from plant to plant (Tóth, Papp, 2013; Linde, Zhan, 2014).

There are various methods to prevent or combat smut disease. For example, the use of fungicides: Chemical agents, especially fungicides, can be effective in combating fungal diseases. However, fungicides must be applied in the correct dosage and at the appropriate time to ensure their effectiveness and avoid harming the plants. Growing the same crops in the same area every year can lead to the spread of fungal diseases. By practicing crop rotation and planting different types of plants, these diseases can be prevented (Singh, Gupta, 2017; Wilson, Nichols, 2016). Additionally, damaged plant

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parts, particularly rotting leaves and fruits, should be promptly cleaned and removed to reduce the spread of the disease. This will help prevent the spread of fungal spores. The growing conditions of the plants should be properly managed. In particular, good ventilation should be ensured to prevent high humidity on the plants. Biological control methods can also be used to prevent fungal diseases. For example, certain microbial products or other natural antimicrobials can destroy fungal spores, providing a natural way to combat the disease (Muradov, Bakshaliyeva, Arabova, Iskandar, 2024; Zambare, Jha, 2020).

Conclusion

Finally, it was concluded that the class *Ustomycetes* primarily encompasses fungi that cause smut diseases in plants. The members of this class affect various parts of plants, especially the leaves, stems, and roots, leading to serious health issues. These diseases can result in crop losses in agriculture and the degradation of plant cover. Smut diseases caused by *Ustomycetes* spread more rapidly under high humidity conditions, particularly during the fall and spring seasons. The most notable symptoms of the disease are the appearance of various colored and shaped spots on plants. In the early stages of the disease, yellow or white spots, and sometimes gray and green spots, appear on the plant leaves. These spots mainly develop on the underside of the leaves and gradually expand, covering more area. In many cases, plant death and crop loss occur. The damage to the leaves reduces the plant's ability to photosynthesize, weakening its overall growth. The disease can also affect the roots and stems of plants, making it difficult for the plant to absorb nutrients and water.

Smut diseases caused by *Ustomycetes* spread more rapidly in humid environments and under high-temperature conditions. The spores are disseminated through water and wind, increasing the risk of infection. Even over short distances between plants, the spread of the infection is possible. The main factors contributing to the spread of the disease include high humidity: *Ustomycetes* pathogens thrive in moist and water-saturated environments, which leads to the rapid spread of the disease, especially during rainy and humid weather. Infected plant material: The roots and leaves of affected plants serve as another factor in spreading the disease. In most cases, smut diseases proliferate more rapidly when transmitted by pests. For instance, insects and other arthropods can carry these spores from one plant to another, further accelerating the spread of the disease. There are several approaches to combating smut diseases, with the aim of halting the spread of the infection and protecting plant health. The most effective control methods are outlined as follows:

First, chemical treatment is the most common method for combating smut diseases. Fungicides are used to prevent infection or reduce the effects of the disease. It is recommended to apply fungicides to infected plants during early stages. This helps prevent the spread of spores and limits the progression of the disease. For example, fungicides such as mancozeb, metalaxyl, or maneb are commonly used to combat these diseases. Another method of control is the removal and destruction of infected plant parts. This helps prevent the further spread of the infection. Damaged plant parts should be promptly cleaned and removed, as they increase the risk of transmission to other healthy plants.

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Study of Productivity Indicators of Saanen Goats

Abstract

The experiments were carried out in the breeding goat farm of "BMS Agro" LLC, Aghjabedi region of the Republic of Azerbaijan. The results of the study show that the use of Saanen dairy goats to improve the milk production and milk quality. The goat breeding helps to significantly increase the milk production of local goat breeds. The milk yield of purebred goats are breeding on the farm is 4.05, the milk yield of hybrid goats is 885 kg on average, and the milk yield of hybrid goats with 4.15% fat is 708 and 453 kg, respectively, more than local goats. Lactation yield is 177 kg of milk with a fat content of 4.37%. The results of the study show that the breeding value of Saanen goats is high. It is appropriate to use these breeds to increase the milk and meat productivity of local goat breeds.

Keywords: *goat, productivity, pure blood Saanen goat, hybrid goat, local goat breed of Azerbaijan, live weight, lactation period*

Introduction

One of the profitable areas of animal husbandry is goat farming. Goat farming has been developing rapidly all over the world in recent years. Meat, vitamin-rich milk, leather and wool products are obtained in the goat farming sector. Goats are not very demanding on feed, and compared to other animals, they have the ability to use various plant species (more than 600 plant species). The extremely favorable natural climatic conditions of Azerbaijan and pastures rich in various types of feed allow the development of goat farming in our homeland (Abbasov, 2011).

Goat breeding leads to the efficient use of pasture, and valuable raw materials, such as wool, mohair and leather, as well as food products such as milk and meat, are obtained from them. In its pure form, very high-quality mahud, carpets are made from goat wool, and high-quality fabrics, mahud, carpets, and woolen covers are made from sheep wool. Goat skin is used in the leather industry and fur production (Sadigov, 2022). Processed goat skin is very strong, elastic, light, and dyes very well. Like sheep, goats have elongated faces, mobile lips, and sharp teeth that break and eat grass from the very bottom. Goats' stomachs are more accustomed to roughage. The wool cover consists of mohair and hair, and the mohair and hair do not change at the same time. Mohair is usually obtained from goats by combing, and hair is obtained by shearing (Gozelov, 2018).

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Research

Goat breeding leads to the efficient use of pasture, and valuable raw materials, such as wool, mohair and leather, as well as food products - milk and meat, are obtained from them. Goat mohair is used in wool processing enterprises, in the mohair and felt industries. In its pure form, goat wool is used to make very high-quality mahud, carpets and high-quality fabrics, such as mahud, carpets, blankets, plush velvet and decorative fabrics, mixed with sheep wool. Goat skin is used in the leather industry, in the production of fur, in the production of very valuable leather - chevro, suede, safyan. Processed goat skin is very strong, elastic, light, and dyes very well (Abdullayev, 2014).

According to research scientists, 50% of the numerous goat breeds bred in the world are dairy breeds. The main product obtained from these goats is milk with high nutritional value. In general, goat milk is very rich in nutrients, especially high-value proteins, vitamins, and macro- and microelements. The diameter of the fat globules in goat milk is 2 times smaller than in cow's milk and the ideal ratio of minerals allows it to be well digested and assimilated by infants and young children (Vladimirov, 2010).

It is a goat breed bred in the Saanen Valley of Switzerland and widely distributed there. This breed has been taken to all parts of the world. It is generally a breed with high adaptability and a strong constitution. Saanen goats are brown, and the males are horned. As a similar feature, the goats have earlobes, short and white hair. It is a cassava-type blue pea mammal with the udder (umbilicus) well located between the two thighs. It has a high growth rate, milk and fertility. Thanks to its ability to adapt to different climatic conditions, it adapts very quickly to the places it is taken to (Abbasov, 2015).

Saanen goats are very sensitive to feeding and nutrition conditions. High productivity (productivity) is achieved only under good care and feeding conditions. Saanen goats have a high feed utilization capacity, reach sexual maturity at an early age and reproduce quickly. This is the most important breeding advantage of the Saanen breed. The breed with high fertility usually gives birth to twins or triplets (Revyakin, 2010).

Location, material and methodology of the study. 330 Saanen goats, the famous Swiss dairy Saanen goats, were brought to the breeding goat farm of "BMS Agro" LLC in the Aghabeyli village of the Agjabadi region. It is planned to increase the number of goats to 4,000 heads. After the goats of this breed multiply, they will be sold to households, family peasants and individual farms. They will be used to improve the breed composition of goats in Azerbaijan. A large goat breeding complex has been built and put into operation in the village of Aghabeyli. The Swiss dairy Saanen goat breed is used to increase the productivity of local goats bred in the breeding goat farm of "BMS Agro" LLC. Saanen goats were first bred in Switzerland. Currently, it is bred in many European countries and also in the Republic of Turkey. The Saanen breed is white and cream in color, short-haired and hornless. Its skin is thin, elastic and pink in color. Its hair is short, shiny and dense (Tagiyev, Mammadov, Suleymanov, 2023). In females, the head is delicate, the eyes are large and bright, the ears are thin and slightly drooping or erect. The body structure is deep and long and wide towards the back, the neck is thin and long. The udder is well developed in accordance with the direction of milk, and spreads under the belly and towards the hind legs. Saanen goats are dairy goats. During the lactation period, they give 750-1000 kg of milk. The fat content of the milk is 4.4-4.6%. The live weight of the female goats is 50-55 kg, and the live weight of the males (goats) is 70-75 kg. 170-180 goats are obtained from every 100 female goats. The meat of Saanen goats is lean. The net meat yield of young goats of medium fatness is 48-50%. They easily adapt to different climatic conditions (Abdullayev, Aliyev, 2012).

Discussion of results. The results of a long-term study conducted at the breeding goat farm of "BMS Agro" LLC in Agjabadi district show that the use of the Swiss dairy Saanen goat breed, both

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in breeding and in improving the low-yielding local goat breed of Azerbaijan, leads to an increase in the milk and meat productivity of the local goat breed and the marketable quality of the products obtained. The results of the experiment are given in the table below (table 1).

Table 1.
Productivity indicators of experimental animals.

Type and sex of animals	Fertility indicators of experimental animals (average 1 head)						
	Number of experimental animals	Live weight (kg)	Milk yield during lactation (kg)	Fat percentage of milk	4% fat milk (kg)	Increase in weight compared to local breed-kg	
						Milk	Live weight
Purebred Saanen goat	5	58	885	4,05	896	708	20
Hybrid goat	5	52	630	4,15	653	453	14
Local goat breed of Azerbaijan	5	38	177	4,37	193	-	-

Table 1 shows that 885 kg of milk with 4.05% fat content was obtained from the Swiss Saanen goats bred on the farm during the milking period, and 630 kg of milk with 4.15% fat content was obtained from the crossbred goats, which resulted in 708 and 453 kg of additional milk production compared to the local breed, respectively (Vladimirov, Yerokhin, Karasyov, Yuldashbayev, Vladimirova, 2010).

The use of Saanen goats in the improvement of local goats leads to an increase in the live weight of local goats and an increase in the calving ability. In order to increase the milk yield of goats and improve the quality of milk, it is necessary to organize full-value feeding of goats throughout the year (Zeynalov, 2008).

Conclusion

Our research work has shown that improving the local goat breed allows us to increase the marketable quality and nutritional value of the produced goat milk and provide our people with high-quality milk and dairy products. It is possible to feed these goats indoors. 0.75-1 sq.m. is enough for one goat, 1.25-1.5 sq.m. for a goat with kids, 3.4 sq.m. for heifers, and 1.5 sq.m. for full-grown goats. Saanen goats give milk for 270-280 days a year, the fat content of the milk is more than 3 percent. Saanen goats, which have high calving rates, give birth to one calf in the first birth and 2-3 calves in subsequent births. In a farm of 25 heads, the number of goats reaches about 150 in two years. In this regard, keeping Saanen goats is considered profitable for farmers. Farms with Saanen goats imported from abroad have already been established in many regions of Azerbaijan. The high demand for goat milk and goat cheese ensures that these farms operate profitably.

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Comparative Analysis of Soft Wheat Varieties

Abstract

This study focuses on the comparative evaluation of two soft wheat (Triticum aestivum L.) varieties “Lucilla” and “Midas” introduced from Turkey, against selected local wheat cultivars under the agro-climatic conditions of Azerbaijan. Given the increasing importance of wheat production in ensuring national food security, identifying high-yielding, stress-tolerant, and adaptable varieties has become a critical objective. The research aims to assess key agrobiological traits such as growth period, plant height, yield components, and resistance to biotic and abiotic stress factors. Field experiments were conducted under local farming conditions to determine the productivity and environmental adaptability of these varieties. The findings are expected to reveal the potential of “Lucilla” and “Midas” for broader application in Azerbaijan's wheat production systems and to offer recommendations for their use in breeding programs or direct cultivation in stress-prone regions.

Keywords: *soft wheat, introduced wheat varieties, spike analyses, productivity indicators, comparative evaluation of wheat varieties*

Introduction

Relevance of the research topic. The development of grain growing in Azerbaijan is one of the strategic directions of the agricultural sector. In recent years, special attention has been paid to wheat production within the framework of state programs implemented to ensure food security. At the same time, the creation of new wheat varieties suitable for local conditions or the introduction of promising foreign varieties into the country is ensured (Abbasov, 2011, p. 452). Increasing the productivity of wheat, the main food crop, is one of the main goals in this area. Experience shows that the factors affecting the productivity of plants are divided into two main groups: cultivation technologies and the quality of the varieties used. According to experts, 60–70% of productivity depends on progressive agrotechnical measures, and 30–40% on the genetic potential of the variety. Therefore, the selection of high-quality varieties adapted to local conditions is of particular importance for our research work. (Indicators characterizing sustainable development, 2018).

The aim of the research

The aim is to determine the potential for adaptation to local conditions of the "Lucilla" and "Midas" soft wheat varieties selected by the Turkish company "Progen AŞ" by testing them in various agro-ecological zones of Azerbaijan and to select the most promising sample based on a comparative analysis of these varieties with local varieties in terms of productivity, quality and sustainability (Progenseed).

Research

Wheat (Triticum aestivum) is one of the most strategically important cereal crops and belongs to the Poaceae (Gramineae) family. The main economically important species within this plant genus are durum and common wheat. In total, about 22 species of wheat are known, of which soft wheat (Triticum aestivum) is considered the most widespread. Common wheat is represented by both spring and autumn forms, and its species diversity includes such forms as lutescens, erythrospermum, ferrugineum and milturum (Mammadov, Ismayilov, 2021, p. 460). Winter wheat forms three radicles when germinating, while spring wheat forms five. While the growth cone of winter wheat develops later, this process is faster in spring wheat. (Gurbanov, 2017). The authors studied some physiological and agronomic characteristics of introduced soft and hard wheat genotypes as a result of their research. The dynamics

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of dry biomass, net productivity of photosynthesis, relative water content, amount of photosynthetic pigments and other agronomic indicators of wheat samples grown in different nurseries were studied. In addition, the ripening period of wheat genotypes in nurseries mainly varied between 50-55 days (Allahverdiyev, Jahangirli, Ibrahimova, 2021, pp. 27-34). Seed germination occurs only in viable specimens, and the presence of certain factors is important for this process to occur. Basically, sufficient moisture, suitable temperature, oxygen, and light for some plants are required for seed germination (Humbatov, Mammadov, Nazaraliyeva, 2023). Wheat belongs to the family of the Cereals and is one of the most widespread and rich genera. The leaf blades are narrow and weakly serrated, and the auricles are small, pointed, and in many varieties, ciliate. The stem consists of 5-6 segments, and the inside of the segments can be empty, half-filled, or completely filled (Mammadov, Ismayilov, 2020).

The main goal of the study is to conduct selection evaluation of newly created hybrids by the introduced and intraspecific hybridization method and to prepare starting material for soft wheat selection with rich genetic diversity, high transgressive traits and technological qualities, resistant to biotic and abiotic stress factors (Nazarov, 2021). Harvesting grain at the optimal time and using the correct technique is of great importance in terms of increasing productivity and minimizing losses.For healthy growth and high yield, wheat plants require nutrients such as nitrogen, potassium, phosphorus, sulfur, magnesium, iron, manganese, zinc, copper, and calcium (Sadigov, Karimov, Sadikova, 2019). New varieties must be resistant to abiotic stress factors such as climate change and water scarcity, and must be able to adapt quickly to different soil and climate conditions (Hasanova, 2015). Only such varieties can spread to regions with different soil and climate conditions and ensure high yields (Abdullaev, 2012, pp. 5-6)

The results of spike analysis
Table1.

	Variants	Spike length, cm	Number Of spikelets in a spike, in numbers	Number of grains in the ear, number	Weight of grains in one spike, g	Number of grains per plant, number	Weight of grains in a plant, g	Absolute weight of grain, gr
	Lucilla	8,5	27	35	1,8	185	9,4	37
	Midas	11	24	32	1,4	175	8,4	31
	Tunc	9	25	33	1,5	180	8,6	32

The height and development of plants in different vegetation phases of wheat were studied for the studied varieties “Lucilla”, “Midas” and “Tunc” (control). As a result, the length of the spike was found to be 8.5 cm in the introduced soft wheat variety “Lucilla”. It is 9 cm in the local soft wheat variety “Tunc” (control). The number of spikelets in the spike in the “Lucilla” soft wheat variety is 27. The number of spikelets in the spike in the “Midas” soft wheat variety is 24, and in the “Tunc” (control) soft wheat variety this indicator is 25. The number of grains in the spike is 35 in the “Lucilla” soft wheat variety, 32 in the “Midas” soft wheat variety, and 33 in the “Tunc” (control) soft wheat variety.

The weight of grains in one spike was 1.8 grams in the “Lucilla” soft wheat variety, 1.4 grams in the “Midas” soft wheat variety, and 1.5 grams in the “Tunc” (control) soft wheat variety. The number of grains in one plant was 185 in the “Lucilla” soft wheat variety, 175 in the “Midas” soft wheat variety, and 180 in the “Tunc” (control) soft wheat variety. The weight of grains in one plant was 9.4 grams in the “Lucilla” soft wheat variety, 8.4 grams in the “Midas” soft wheat variety, and 8.6 grams in the “Tunc” (control) soft wheat variety. The absolute weight of the grain for each

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variety was 37 grams in the “Lucilla” soft wheat variety, 31 grams in the “Midas” wheat variety, and 32 grams in the “Tunc” (control) soft wheat variety.

Conclusion

As a result of the research, it was determined that the Lucilla and Midas soft wheat varieties introduced from Turkey have a number of superior agronomic and technological indicators compared to local varieties. These varieties are distinguished by higher productivity, early vegetation period, resistance to diseases and pests, as well as high technological qualities.

The Lucilla variety was selected for its high productivity (58.9 s/ha), baking indicators and resistance to diseases. The Midas variety also showed high results in this regard and was especially notable for its early ripening ability. These results show that both introduced varieties are suitable for cultivation in Azerbaijani conditions and are promising.

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