ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

**2021 • 2**

**ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ**

# БАЯНДАМАЛАРЫ

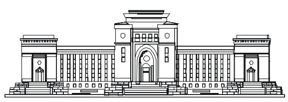
# ДОКЛАДЫ

**НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН**

# REPORTS

**OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN**

PUBLISHED SINCE 1944



ALMATY, NAS RK

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
**БАЯНДАМАЛАРЫ** **2021 • 2**



**«Қазақстан Республикасы Ұлттық ғылым академиясының баяндамалары»**
**ISSN 2518-1483 (Online),**
**ISSN 2224-5227 (Print)**

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» Республикалық қоғамдық бірлестігі (Алматы қ.).
Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ93VPY00025418** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

**Тақырыптық бағыты:** ***наноматериалдар алу, биотехнология және экология саласындағы бірегей зерттеу нәтижелерін жариялау.***

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.
Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28; 219 бөл.; тел.: 272-13-19, 272-13-18

http://reports-science.kz/index.php/en/archive



Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

**ДОКЛАДЫ** **2021 • 2**
НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН



**Доклады Национальной академии наук Республики Казахстан»**
**ISSN 2518-1483 (Online),**
**ISSN 2224-5227 (Print)**

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).
Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ93VPY00025418**, выданное 29.07.2020 г.

**Тематическая направленность:** ***публикация оригинальных результатов исследований в области получения наномате-риалов, биотехнологии и экологии.***

Периодичность: 6 раз в год.
Тираж: 300 экземпляров

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28; ком. 219; тел. 272-13-19, 272-13-18

http://reports-science.kz/index.php/en/archive



Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

**REPORTS** **2021 • 2**
OF NATIONAL ACADEMY OF SCIENCES OF THE
REPUBLIC OF KAZAKHSTAN



**Reports of the National Academy of Sciences of the Republic of Kazakhstan.**
**ISSN 2224-5227**
**ISSN 2518-1483 (Online),**
**ISSN 2224-5227 (Print)**

Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ93VPY00025418**, issued 29.07.2020.

**Thematic scope:** ***publication of original research results in the field of obtaining nanomaterials, biotechnology and ecology.***

Periodicity: 6 times a year.
Circulation: 300 copies.
Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19, 272-13-18

http://reports-science.kz/index.php/en/archive



Address of printing house: ST "Aruna", 75, Muratbayev str., Almaty.

**REPORTS OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN**
ISSN 2224-5227
Volume 2, Number 336 (2021), 39 – 45 **https://doi.org/10.32014/2021.2518-1483.28**

UDC 615.322:577.21

**A. M. Digarbaeva[1], A. N. Kaliyeva[1], E. A. Kirshibayev[2], M. R. Bahtybaeva[1]**

[1]Kazakh National Women's Teacher Training University, Almaty, Kazakhstan;
[2]Al-Farabi Kazakh National University Almaty, Kazakhstan.
E-mail: digarbaevaasem@gmail.com

# INFLUENCE OF HEAVY METALS ON THE DEVELOPMENT OF CORN VARIETIES

**Abstract.** Heavy metals are some of the most harmful chemicals in the environment today.

Today, many scientists believe that the main factor that negatively affects the plant in saline conditions is the osmotic effect of salts. In conditions of soil salinity, the lack of plants causes dehydration of proteins, which negatively affects the physiological and biochemical processes of plants.

Plants absorb heavy metals in different ways. It absorbs heavy metals from the soil through the roots and from the air through the stomata of the leaves, mainly through dust.

The aim of the research is to study the influence of heavy metals on the physiological and biochemical processes of growth and development of maize varieties.

The article presents the research results of the heavy metals influence on the elongation of seedlings and the synthesis of photosynthetic pigments during the germination of maize varieties. It is obvious that heavy metals affect the growth and plant development from the initial germination stage of corn kernels. The results of monitoring various effects of heavy metals on photosynthetic pigments are also presented. In addition, the length of the above-water and underground parts of the biomass, the ratio of dry weight to actual weight is the heavy metals effect on plants. For example, the leaves turned dark green, the stems twisted, did not fully open and turned pink. Under the influence of heavy metals, plant development, metabolism and photosynthesis are disrupted, as well as the normal course of respiration and photosynthesis.

According to the results obtained, the impact of heavy metals on maize varieties significantly inhibits the accumulation and growth of biomass. In particular, the processes of plant root growth are suppressed. Differences in the tolerance of different varieties of heavy metals can be explained by their varietal characteristics and genetic basis. Currently, there is a theoretical and practical interest in the identification of ion-resistant forms of heavy metals, their ability to detect and reveal their nature, the development of ways to increase the impact and resistance of heavy metals on plants. Formulating the results of the study, it was found that different heavy metals concentrations (CuSO4 and CdSO4) negatively affect the growth of corn varieties. This can be seen from the tables below (tables 1, 2, 3, 4).

**Key words:** maize varieties, heavy metals, CdSO4, CuSO4, germination, growth, biomass.

**Introduction.**The ecological situation in many regions of Kazakhstan is not critical. Scientific and technological progress is accompanied by large-scale environmental pollution in violation of the existing natural balance. Many regions of the country are polluted with gaseous, liquid and solid industrial wastes, sulfates and heavy metals.

Today, the propagation of heavy metals in the environment is not only natural, but also anthropogenic. These include mining, industrial waste, transportation, production of non-ferrous and ferrous metals, indiscriminate use of fertilizers containing heavy metals and general urbanization. Therefore, cleaning and preserving the environment from heavy metal ions is an urgent task. The physical, chemical and biological methods for the restoration of a polluted environment are known [1,8].

Water deficiency and soil and air salinization in our republic is one of the most common abiotic stresses that threaten the life of plants, suppress their growth and reduce productivity. Therefore, scientific research on the creation of new varieties of anti-stress crops that increase their resistance is relevant [2]. Today, many scientists believe that the main factor that negatively affects the plant in saline conditions is the osmotic effect of salts. In conditions of soil salinity, the lack of plants causes dehydration of proteins, which negatively affects the physiological and biochemical processes of plants [7.9]. Among cultivated plants relating to different groups of systems, there are differences in the degree of salt tolerance. Therefore, today, in addition to genetic and breeding methods, biotechnological methods are widely used in the field of new scientific technologies to improve the production of corn [3].

Plants absorb heavy metals in different ways. They absorb heavy metals from the soil through the roots and from the air through the stomata of the leaves, mainly through dust. Heavy metals come from aqueous solutions by passive diffusion through the stomata and cuticle and active transport. The first signs of the effect of heavy metals on plants are a growth rate reduction, a decrease in biomass [4].

A factor that affects the environment is called a stress factor. Plants are characterized by three phases of stress: 1) initial response to stress, 2) adaptation, 3) exhaustion.

Determination of plant resistance to heavy metals depends on the amount of heavy metal, its duration and resistance. Stress resistance of plants also depends on the phase of ontogenesis [5].

According to many researchers, the disintegration of heavy metals in plants decreases, especially in general physiological processes, as well as the absorption of trace elements and nutrients, and enzyme systems are disrupted. That is, plant growth rate reduces [6].

**The aim of the research** is to study the influence of heavy metals on the physiological and biochemical processes of growth and development of corn varieties.

**Object and research methods.**The object of the study was corn varieties Turan-170, Turan-480, Kazakhstan-435, Tauelsizdik-20 (ZeaMais). The solutions of copper - CuSO4 (CuSO4 + 5H2O) and CdSO4 - (CdSO4 + 8H2O) cadmium were obtained as heavy metals at different concentrations (3 mg/L, 5 mg / L, 10 mg / L and 175 ml of distilled water H2O per 1 ml / container).

Cereals containing heavy metals in water, including corn, were grown and monitored to determine the effect of CuSO4-copper and CdSO4-cadmium. The required number of grains from 4 varieties was removed and purified by shaking it several times with distilled water. In addition, to clean the grain from harmful microorganisms, corn seeds were soaked in a weak solution of potassium permanganate (KMnO4) for 10 minutes and washed again with distilled water. Grains of corn varieties were placed in containers with 50 concentrations of physiological solution of different concentrations and placed in three replicates (D.V. Vaseleva, Z.M. Koloshina (1970).

The germination rate of the corn varieties was observed for 3, 5 and 7 days from the day of sowing. Growth rate: germination is determined by the unit of growth, length and number of roots (D.V. Vaseleva, Z.M. Koloshina (1970). Distilled water was poured in the required amount daily for 14 days. After 14 days, the bioparametric parameters of corn varieties were determined in dependence on the elongation of the underground and surface organs of the varieties and the accumulation of dry matter biomass (G.V. Udovenko, L.A. Semushina, V.N. Sinelkinova (1976), chlorophyll-a, horophyll-b and carotenoids involved in the process of photosynthesis (according to Holm - Wetstein's Formula) for each heavy metal.

**Obtained data and their analysis.**During the experiment, it was observed that heavy metals have different effects on the germination rate of corn varieties, and the results of the study were presented (table 1, figure 1). Looking at the quantitative data presented in the table, you can see some differences in the germination rate of corn varieties.

Table 1 - Influence of heavy metals on the germination rate of corn varieties

| No. | Tauelsizdik – 20 | | Kazakhstan – 435 | | Turan – 170 | | Turan – 480 | |
|---|---|---|---|---|---|---|---|---|
| | 3 day germination rate | | | | | | | |
| | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ |
| Observation | 48±4,5 | 47±4,7 | 48±4,8 | 47±4,7 | 50±4,9 | 49±4,8 | 49±4,8 | 50±4,8 |
| 3 mg/l | 48±4,5 | 45±4,4 | 47±4,6 | 48±4,7 | 48±4,4 | 49±4,8 | 48±4,7 | 48±4,5 |
| 5 mg/l | 35±3,4 | 32±3,2 | 31±3,0 | 31±3,1 | 37±3,5 | 35±3,4 | 37±3,5 | 30±2,9 |
| 10 mg/l | 26±2,5 | 25±2,0 | 26±2,5 | 25±2,5 | 27±2,5 | 26±2,5 | 25±2,3 | 26±2,5 |
| 5-day germination rate | | | | | | | | |
| Observation | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ |
| | 48±4,6 | 48±4,7 | 50±4,9 | 49±4,8 | 50±4,8 | 49±4,8 | 49±4,8 | 50±4,8 |
| 3 mg/l | 48±4,7 | 49±4,8 | 47±4,7 | 48±4,7 | 47±4,5 | 48±4,5 | 48±4,7 | 49±4,5 |
| 5 mg/l | 36±4,5 | 35±3,5 | 32±3,2 | 31±3 | 35±3,1 | 33±3,2 | 37±3,6 | 33±3,1 |
| 10 mg/l | 26±2,5 | 26±2,5 | 27±2,6 | 26±2,3 | 28±2,6 | 28±2,8 | 28±2,7 | 27±2,5 |

| 7-day germination rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Observation | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ | $CuSO_4$ | $CdSO_4$ |
| | 48±4,1 | 48±4,5 | 48±4,6 | 49±4,7 | 50±4,7 | 49±4,5 | 49±4,8 | 50±4,8 |
| 3 mg/l | 48±4,5 | 48±4,3 | 47±4,5 | 48±4,6 | 47±4,5 | 48±4,6 | 49±4,8 | 49±4,7 |
| 5 mg/l | 36±3,2 | 36±3,2 | 32±3,1 | 33±3,1 | 35±3,4 | 34±3,1 | 37±3,6 | 33±3,3 |
| 10 mg/l | 26±2,1 | 26±2,2 | 29±2,3 | 28±2,5 | 30±2,5 | 30±2,5 | 30±2,9 | 29±2,8 |

The analysis of the germination rate of corn varieties Turan-480, Turan-170, Kazakhstan-435, Tauelsizdik-20 in solutions with different concentrations of CuSO4 and CdSO4 showed that the growth rate of grains in a concentrated solution is 3 mg/l. CdSO4 was 3% higher in 3 days. Increased production of Turan-170, Turan-480 in a concentrated solution of CuSO4 5 mg/l. In a concentrated solution of CuSO4 and CdSO4 10 mg/l, the germination rate after 7 days was lower than after 5 days, and the influence of heavy metals began to appear. For example, on the 7th day, the growth of roots and stems slowed down in seeds germinated on the 3rd day. We have seen that heavy metals have a significant effect on the germination rate of corn varieties.

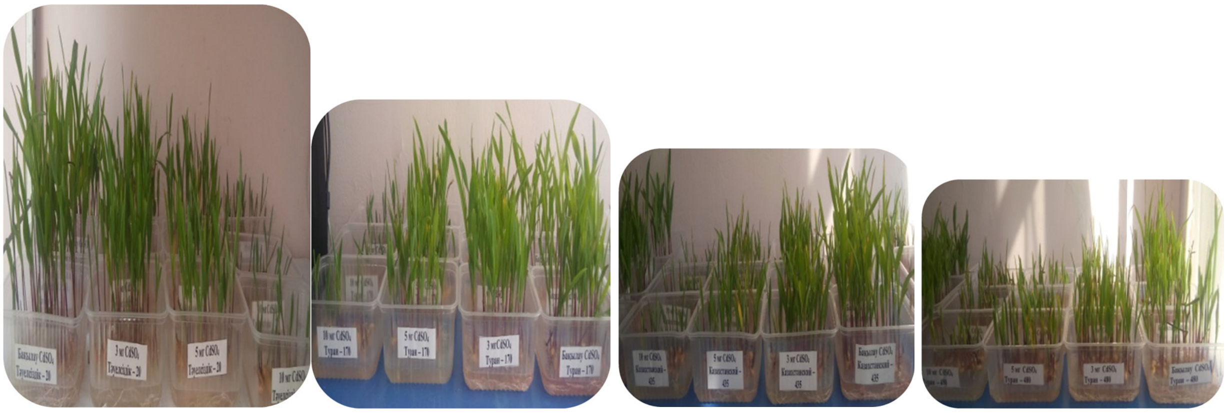


Figure-1 Conditions for growing varieties of corn under the influence of heavy metals.

In the table, the lowest seed germination rate was noted for the variety Tauelsizdik-20, and the highest - 100 and 97% - for the variety Turan-480. The first young crops in all studied varieties after 2 days, germination increases after 3 days, and after 4 days the normal bark of the seedling begins to develop. After 4 days, seed germination is 64.0-100%, depending on the variety. Since the seed yield depends on the genotype, the yield does not change.

Table 2 - Influence of heavy metals on the growth of vegetative organs of corn varieties (bioparametric indicators of 14-day seedlings)

| $CuSO_4$ | Turan – 170 | | Kazakhstan – 435 | | Turan – 480 | | Tauelsizdik – 20 | |
|---|---|---|---|---|---|---|---|---|
| | Stem length (medium, cm) | Root length (medium, cm)/pc.) | Stem length (medium, cm) | Root length (medium, cm)/pc.) | Stem length (medium, cm) | Root length (medium, cm)/pc.) | Stem length (medium, cm) | Root length (medium, cm)/pc.) |
| Observation | 18±1,7 | 19±1,8 | 17±1,6 | 20±1,5 | 21±2,0 | 23±2,3 | 16±1,6 | 18±1,8 |
| 3 mg/l | 15±1,5 | 10±1,0 | 12±1,2 | 5±0,5 | 16±1,5 | 17±1,6 | 12±1,2 | 11±1,0 |
| 5 mg/l | 13±1,2 | 5±0,5 | 10±0,9 | 3±0,3 | 12±1,2 | 6±0,5 | 10±1,0 | 3±0,3 |
| 10 mg/l | 8±0,7 | 1±0,8 | 6±0,5 | 0,3±0,03 | 7±0,7 | 3±0,3 | 6±0,5 | 0,8±0,09 |
| $CdSO_4$ | Turan – 170 | | Kazakhstan - 435 | | Turan – 480 | | Tauelsizdik – 20 | |
| Observation | 18±1,0 | 15,5±1,5 | 14,4±1,4 | 17,9±1,6 | 20,4±1,9 | 23,3±2,2 | 17,3±1,6 | 16,5±1,5 |
| 3 mg/l | 16,5±1,5 | 10,95±1,0 | 12,8±1,2 | 11±1,0 | 16,8±1,5 | 17,7±1,7 | 11,3±1,1 | 5,9±0,5 |
| 5 mg/l | 10,2±0,9 | 3,4±0,3 | 8,5±0,7 | 2,5±0,2 | 12,6±1,1 | 4,8±0,4 | 8,7±0,8 | 2,5±0,2 |
| 10 mg/l | 7,4±0,7 | 0,4±0,004 | 7,6±0,6 | 0,3±0,01 | 7,6±0,7 | 0,4±0,004 | 5,9±0,5 | 0,2±0,02 |

Comparative analysis of indices of vegetative organs of corn varieties CuSO4 and CdSO4 in solutions of different concentrations showed that Turan - 170, Turan - 480 are resistant varieties. According to the results of experiments by hydroponic screening in the laboratory, resistance of these varieties to heavy metals was found.

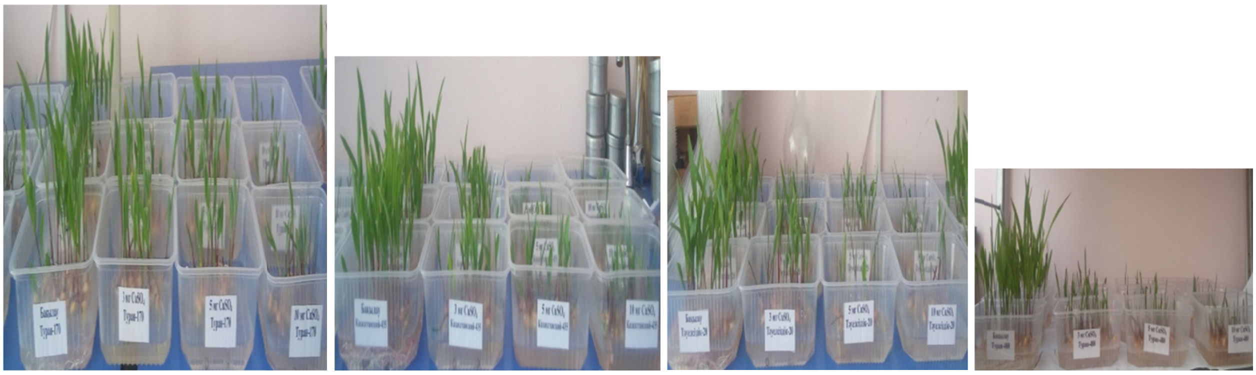


Figure – 2 Influence of heavy metals on the growth of vegetative organs of corn varieties (bioparametric indicators of 14-day seedlings)

Table 3 – Indicators of the resource intensity of grain of 14-day seedlings of corn varieties

| $CuSO_4$ | Turan – 170 | | Turan – 480 | | Kazakhstan - 435 | | Tauelsizdik – 20 | |
|---|---|---|---|---|---|---|---|---|
| | Weight of 1 grain | Dry/g | Weight of 1 grain | Dry/g | Weight of 1 grain | Dry/g | Weight of 1 grain | Dry/g |
| Observation | 2,789±0,5 | 0,965±0,1 | 2,645±0,5 | 0,973±0,18 | 2,458±0,7 | 1,210±0,1 | 2,712±0,4 | 1,249±0,1 |
| 3 mg/l | | 1,298±0,1 | | 1,125±0,2 | | 1,423±0,2 | | 1,533±0,3 |
| 5 mg/l | | 1,501±0,1 | | 1,491±0,2 | | 1,843±0,1 | | 1,897±0,2 |
| 10 mg/l | | 1,954±0,2 | | 1,969±0,2 | | 2,315±0,1 | | 2,389±0,1 |
| $CdSO_4$ | Turan – 170 | | Turan – 480 | | Kazakhstan - 435 | | Tauelsizdik – 20 | |
| | Weight of 1 grain | Dry/g | Weight of 1 grain | Dry/g | Weight of 1 grain | Dry/g | Weight of 1 grain | Dry/g |
| Observation | 2,765±0,5 | 1,097±0,14 | 2,454±0,5 | 0,985±0,11 | 2,574±0,7 | 1,064±0,1 | 2,589±0,4 | 1,185±0,08 |
| 3 mg/l | | 1,202±0,16 | | 1,179±0,15 | | 1,497±0,1 | | 1,243±0,9 |
| 5 mg/l | | 1,864±0,16 | | 1,754±0,18 | | 1,821±0,2 | | 1,750±0,1 |
| 10 mg/l | | 2,001±0,15 | | 1,943±0,16 | | 2,226±0,4 | | 2,245±0,3 |

The indicators in the table above had a significant impact on the consumption of raw materials in grains of corn varieties under the influence of various concentrations.

According to the results of the study, initially 1 grain of the variety Turan-170 weighed 2.712 g, and after 14 days the stock consumption was 2.389 g, that is, only 10% of the reserves were used up. This is due to the fact that the action of heavy metals passes through the veins, which significantly slows down the growth of roots.

In general, the influence of CuSO4 and CdSO4 on corn varieties was determined in the course of experimental work. Experiments with CdSO4 also showed that corn varieties grew and germinated much faster, but after 12 days of growth, the plant's stems and leaves began to fold on their own. In CuSO4, plant growth was slow, but no changes were observed in plant stems and leaves.

Exposure to heavy metals has been found to negatively impact the growth of corn varieties. It is noticed that these values increase with increasing concentration of heavy metals. Such indicators can be seen in the table above (table 3).

Table 4 - Effect of different concentrations of copper sulfate
on photosynthetic pigments in 14-day-old seedlings of corn varieties

| Corn varieties | Leaf pattern, mg. | Carotenoid (on average) µg / ml | Chlorophyll-a (average) µg / ml | Chlorophyll-b (average) µg / ml |
|---|---|---|---|---|
| **$CdSO_4$** | | | | |
| **Turan -170** | | | | |
| Observation | 20 | 3,3±0,3 | 14,85±1,4 | 15,12±1,4 |
| 3 mg/l | 20 | 2,63±0,2 | 14,91±1,3 | 12,5±1,1 |
| 5 mg/l | 20 | 1,81±0,1 | 13,7±1,3 | 7,4±0,7 |
| 10 mg/l | 20 | 1,41±0,1 | 13,48±1,3 | 9,59±0,9 |
| **Turan -480** | | | | |
| Observation | 20 | 4,78±0,4 | 15,78±1,3 | 21,71±2,1 |
| 3 mg/l | 20 | 3,89±0,3 | 14,79±1,3 | 17,33±1,6 |
| 5 mg/l | 20 | 3,48±0,3 | 14,84±1,3 | 16,08±1,5 |
| 10 mg/l | 20 | 2,92±0,2 | 14,05±1,3 | 14,18±1,4 |
| **Kazakhstan-435** | | | | |
| Observation | 20 | 3,41±0,3 | 14,98±1,4 | 15,97±1,5 |
| 3 mg/l | 20 | 4,74±0,4 | 14,21±1,4 | 20,74±2,0 |
| 5 mg/l | 20 | 4,75±0,4 | 14,5±1,4 | 20,89±2,0 |
| 10 mg/l | 20 | 4,47±0,4 | 14,9±1,4 | 19,72±1,9 |
| **Tauelsizdik-20** | | | | |
| Observation | 20 | 4,87±0,4 | 14,56±1,4 | 21,2±2,1 |
| 3 mg/l | 20 | 3,57±0,3 | 14,8±1,4 | 18,99±1,8 |
| 5 mg/l | 20 | 3,54±0,3 | 14,03±1,3 | 15,87±1,5 |
| 10 mg/l | 20 | 3,24±0,33 | 14,09±1,3 | 14,75±1,4 |
| **$CuSO_4$** | | | | |
| **Turan -170** | | | | |
| Observation | 20 | 3,2±0,3 | 15,1±1,5 | 17,54±1,7 |
| 3 mg/l | 20 | 2,52±0,2 | 14,21±1,4 | 12,89,5±1,2 |
| 5 mg/l | 20 | 1,02±0,1 | 12,9±1,1 | 8,1±0,8 |
| 10 mg/l | 20 | 1,1±0,1 | 13,01±1,2 | 10,01±0,9 |
| **Turan -480** | | | | |
| Observation | 20 | 4,56±0,4 | 14,01±1,4 | 22,23±2,1 |
| 3 mg/l | 20 | 3,12±0,3 | 15,21±1,3 | 17,0±17 |
| 5 mg/l | 20 | 3,98±0,3 | 14,0±1,4 | 16,85±1,6 |
| 10 mg/l | 20 | 2,02±0,2 | 13,12±1,3 | 14,01±1,4 |
| **Kazakhstan-435** | | | | |
| Observation | 20 | 3,89±0,3 | 15,10±1,4 | 16,07±1,6 |
| 3 mg/l | 20 | 4,81±0,4 | 14,56±1,4 | 21,45±2,0 |
| 5 mg/l | 20 | 4,65±0,4 | 14,0±1,4 | 21,01±2,0 |
| 10 mg/l | 20 | 4,01±0,4 | 13,9±1,4 | 19,98±1,8 |
| **Tauelsizdik-20** | | | | |
| Observation | 20 | 5,0±0,4 | 15,16±1,5 | 22,0±2,0 |
| 3 mg/l | 20 | 4,23±0,4 | 14,89±1,4 | 19,16±1,9 |
| 5 mg/l | 20 | 3,89±0,3 | 14,52±1,4 | 16,05±1,6 |
| 10 mg/l | 20 | 3,45±0,3 | 14,20±1,4 | 15,36±1,5 |

According to the data of the 14-day experiment, the amount of pigment in the concentrations of CuSO4 and CdSO4 is clearly traced during the synthesis of chlorophylls -a and -b, quinoids, compared with the control variant in varieties Turan-170, Turan-480, Tauelsizdik-20. For example, the control variant Turan-170 is 3.3 µg/ml, 3 mg/l -2.63 µg/ml, 5 mg/l-1, 81 µg/ml, 10 ml/l -1.41 µg/ml, carotenoids and the synthesis of chlorophylls -a and -b decreases depending on the concentration. Kazakhstan-435, varieties of the control variant increase the synthesis of chlorophylls -a and -b, carotenoids of various concentrations (3.89 µg/l -4.01 µg/l).

At the maximum concentration of the experiment, it was observed that the leaves of the varieties of corn turned dark green, the stems curled, they did not fully open and turned pink.The data obtained show that the effect of heavy metals is enhanced by an increase in their concentration in the aquatic environment. Moreover, the sensitivity of plants to heavy metals is closely related to the amount of biomass they accumulate in the growing medium.

**Conclusion.** In conclusion, the study showed that the growth of corn varieties was inhibited by different concentrations of heavy metals (CuSO4 and CdSO4). As the concentration of heavy metals increased, the growth rate of plants slowed down and the relations between plant organs changed. They led to a gradual decrease in biomass and negatively affected the consumption of stocks. Under the influence of heavy metals, plant development, metabolism and photosynthesis, as well as the normal course of respiration and photosynthesis are disrupted. Summarizing the results of the study, we can recommend the use of corn varieties such as Turan-170, Turan-480, characterized by a high accumulation of biomass for the selection of corn for resistance to heavy metals.

**А. М. Дигарбаева [1], А. Н. Калиева[1] , Е. А. Кіршібаев[2], М. Р. Бахтыбаева[1]**

[1]Қазақ ұлттық қыздар педагогикалық университеті, Алматы қаласы, Қазақстан;
[2]Әл-Фараби атындағы қазақ ұлттық университеті, Алматы қаласы, Қазақстан;

## АУЫР МЕТАЛДАРДЫҢ ЖҮГЕРІ СОРТТАРЫНЫҢ ДАМУЫНА ӘСЕРІ

**Аннотация.** Бүгінгі таңда ауыр металдар қоршаған ортадағы ең зиянды химиялық заттардың қатарына жатады.

Қазіргі уақытта ғалымдардың көбісі сортаңдану жағдайында өсімдікке кері әсер ететін негізгі фактор болып тұздардың осмотикалық әсері деп санайды. Топырақтың сортаңдану жағдайында өсімдіктерде пайда болған тапшылық өсімдіктердің физиологиялық-биохимиялық процестеріне кері әсер ететін белоктардың дегидратациясын туғызады.

Өсімдіктер ауыр металдарды әртүрлі жолдармен қабылдайды. Топырақтан ауыр металдарды тамыр арқылы сіңіріп, ауадан жапырақ устьицалары арқылы, негізінен шаң-тозаң арқылы қабылдайды

Зерттеу жұмыстың мақсаты ауыр металдардың жүгері сорттарының өсіп-дамуындағы физиологиялық-биохимиялық процестеріне әсерін зерттеу.

Мақалада жүгері сорттарының өніп-өсуіне өскіндердің ұзарып өсуі мен фотосинтездік пигметтердің синтезделуіне ауыр металдардың әсері жайлы зерттеу нәтижелері келтірілген. Ауыр металдар жүгері дәндерінің өну кезеңінен бастап өсімдіктердің өсіп-дамуына да әсер ететіндігі айқын байқалған. Сонымен қатар, ауыр металдардың фотосинтездік пигменттерге әртүрлі әсерін бақылау нәтижелері ұсынылған. Сондай-ақ биомасса жер үсті және жер асты мүшелерінің ұзындықтары, құрғақ салмақтың нақты салмаққа қатынасы өсімдіктердегі ауыр металдардың әсері болып табылады. Мысалы жапырақтарды қою жасыл түске боялып, сабағы ширатылып, толық ашылмауы, қызғылт түске айналғаны байқалды. Ауыр металдардың әсерінен өсімдіктің дамуы, метаболизмі мен фотосинтездің белсенділігі, сонымен қатар, тыныс алу мен фотосинтез процесінің қалыпты жүруі бұзылады.

Алынған нәтижелер бойынша жүгері сорттарында ауыр металдың әсерінен биомасса жинауы мен өсуін айтарлықтай тежейді. Әсіресе өсімдік тамырларының өсу процестері тежелді. Әр түрлі сорттардың төзімділігіндегі айырмашылықтар, ауыр металдарға олардың сорттық ерекшеліктері мен және генетикалық негізіне байланыстылығын аңғаруға болады. Қазіргі кезде ауыр металдар ионына төзімді түрлерін, төзімділігін анықтау және оның табиғатын аша білу, өсімдіктерге ауыр металдардың әсерін және төзімділігін арттыру жолдарын жасау теориялық және практикалық қызығушылық туғызады. Зерттеу нәтижелерін тұжырымдай келе жүгері сорттарының өсуіне ауыр металдардың ($CuSO_4$ және $CdSO_4$) әртүрлі концентрация-ларының кері әсер ететіндігі анықталды. Төменде көрсетілген кестелерден (1, 2 , 3, 4-кестелер) көруге болады.

**Түйін сөздер:** жүгері сорттары, ауыр металдар, $CdSO_4$, $CuSO_4$, өну, өсу, биомасса.

**А.М. Дигарбаева [1], А.Н. Калиева[1], Е.А. Киршибаев[2], М.Р. Бахтыбаева[1]**

[1]Казахский национальный женский педагогический университет, Алматы, Казахстан;
[2]Казахский национальный университет имени Аль-Фараби, Алматы, Казахстан;

## ВЛИЯНИЕ ТЯЖЕЛЫХ МЕТАЛЛОВ НА РАЗВИТИЕ СОРТОВ КУКУРУЗЫ

**Аннотация.** Сегодня тяжелые металлы являются одними из самых вредных химических веществ в окружающей среде.

Сегодня многие ученые считают, что основным фактором, негативно влияющим на растение в условиях засоления, является осмотическое действие солей. В условиях засоления почвы недостаток растений вызывает обезвоживание белков, что отрицательно сказывается на физиологических и биохимических процессах растений.

Растения по-разному поглощают тяжелые металлы. Он поглощает тяжелые металлы из почвы через корни и из воздуха через устьица листьев, в основном через пыль.

Цель исследования - изучить влияние тяжелых металлов на физиологические и биохимические процессы роста и развития сортов кукурузы.

В статье представлены результаты исследования влияния тяжелых металлов на удлинение проростков и синтез фотосинтетических пигментов при прорастании сортов кукурузы. Очевидно, что тяжелые металлы влияют на рост и развитие растений с начальной стадии прорастания кукурузных зерен. Также представлены результаты мониторинга различных эффектов тяжелых металлов на фотосинтетические пигменты. Кроме того, длина надводной и подземной частей биомассы, отношение сухого веса к фактическому весу - это влияние тяжелых металлов на растения. Например, листья стали темно-зелеными, стебли закрутились, не раскрылись полностью и стали розовыми. Под воздействием тяжелых металлов нарушается развитие растений, метаболизм и фотосинтез, а также нормальное течение дыхания и фотосинтеза.

Согласно полученным результатам, воздействие тяжелых металлов на сорта кукурузы значительно тормозит накопление и рост биомассы. В частности, подавляются процессы роста корней растений. Различия в переносимости различных сортов тяжелых металлов можно объяснить их сортовыми особенностями и генетической основой. В настоящее время существует теоретический и практический интерес к идентификации ионо-устойчивых форм тяжелых металлов, их способности обнаруживать и раскрывать их природу, разработке способов повышения воздействия и устойчивости тяжелых металлов на растения. Формулируя результаты исследования, было обнаружено, что различные концентрации тяжелых металлов ($CuSO_4$ и $CdSO_4$) отрицательно влияют на рост сортов кукурузы. Это можно увидеть из таблиц ниже (таблицы 1, 2, 3, 4).

**Ключевые слова**: сорта кукурузы, тяжелые металлы, CdSO4, CuSO4, всхожесть, рост, биомасса.

**Information about authors:**

Digarbaeva Assem Moldazhanovna, PhD, doctoral student of Kazakh National Women's Teacher Training University, Almaty, Kazakhstan; asema_1985.kz@mail.ru;

Kaliyeva Anar Nurgaiypovna, PhD, acting Associated professor, Kazakh National Women's Teacher Training University, Almaty, Kazakhstan; anar.kaliyeva28@gmail.com; https://orcid.org/0000-0003-2429-2610;

Kirshibayev Erlan Ahmetkaliuly, candidate of Biological Sciences. Al-Farabi Kazakh National University Almaty, Kazakhstan er_biol@mail.ru; https://orcid.org/0000-0002-6061-2039;

Bahtybaeva Maira Rinatovna, Master student of Kazakh National Women's Teacher Training University, Almaty, Kazakhstan; bahtybaeva1981@gmail.com; https://orcid.org/0000-0002-0765-853X

## REFERENCES

[1] Sokolov M.S. The possibility of obtaining ecologically safe crop production in terms of agricultural pollution. Agrochemistry, (1995) No. 6 p.107-125.

[2] Kirshibayev E.A., Sarsenbayev B.A., Spakhova Z.B. The influence of heavy metals on some natural cereals // Biotechnology, theory and practice. 2004. №2. B. 90-100.

[3] Ovcharenko M.M. Heavy metals in the soil-plant-satisfaction system // Chemistry in agriculture. 1995. P. 4.

[4] Shkolnitsa N.Ya. Plants under extreme conditions of mineral nutrition P. Ed. L Science, 1983, p. 176

[5] V.I. Plant physiology by Malinovsky. Tutorial. Manual. UDC 581.1 - Vladivostok: Publishing house of the Far Eastern State University, 2004. p-92.

[6] https://doi.org /10.32014/2020.2519-162.28

[7] Kirshibayev E.A., Atabayeva S.D., Sarsenbayev B.A. The influence of copper on the growth and development of some natural cereals // Biotechnology, theory and practice. 2000. №1-2. B. 92-96.

[8] Strogonov B.P. Physiological bases of plant salt tolerance. M., 1962.366 p. 112.

[9] Strogonov B.P. Plant metabolism in saline conditions. M.: Science. 1973 g.

[10] Udovenko G.V. Features of various methods for assessing plant salinity // Methods for assessing plant resistance to adverse environmental factors. L.: Kolos, 1976. S. 228-238.

**Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan**

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the originality detection service Cross Check http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

**ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)**

http://reports-science.kz/index.php/en/archive

Редакторы: *М. С. Ахметова, Д. С. Аленов, Р.Ж. Мрзабаева*

Верстка на компьютере *А. М. Кульгинбаевой*

Подписано в печать 13.04.2021.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
8,5 п.л. Тираж 300. Заказ 2.

*Национальная академия наук РК*
*050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19*