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СОДЕРЖАНИЕ

 THE INFLUENCE OF HEAVY METAL ON THE ANATOMICAL STRUCTURE OF SOYBEAN

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Abstract
As one of the consequences of heavy metal pollution in soil, water and air, plants are contaminated by heavy metals in some parts of Kazakhstan. To understand the effects of heavy metals upon plants in the work we was research the impact of heavy metal Zn on growth and development of soybean. As a result of the analysis of enhanced studying of morphological and anatomical structures of soybean, for the first time there have been determined changes in pa-rameters of morphological and anatomical structures. Long-term experience and researches of anatomical structures of soybean show, that anatomic features, particularly the size of a xylem and phloem, are influenced by various conditions of cultivation. Based on the analysis, it is claimed that with size decreasing of the conducting bundle, a phloem ratio to a xylem changes, in control options, the xylem is usually bigger than a phloem, and under the influence of a heavy metal Zn, the phloem exceeded a xylem. Special attention is paid on xylem ratios to a phloem. The article is devoted to concerns about influence of a heavy metal Zn on morphometric char-acteristics of soy, which had been studied for a long time, and on the basis of the conducted research, To sum up, in case where added Zn morphometric indexes have high value revealed by the results of comparative investigations.
Keywords: Soybean, heavy metal, morphometric, xylem, phloem
Soybean is one of the valuable seed of bean culture. Grain which grown in the production conditions contains from 39 to 42% protein, 19-23% fat and a lot minerals, vitamins. In the nature no one of plants cannot collect the same amount of protein and fat that exactly match the stock substance during the growing season such as butter bean. Butter bean is unprecedented among agricultural crops with the variety and versatile use production, technical and forage crop. Therefore, nowadays interests and attention of scientists in the world given to butter bean [1-5].
Butter bean is not investigated in Kazakhstan conditions. There is a great importance of developing of growing butter bean crop in the Republic, but one of the main barriers to improving the production of butter bean is the lack of connection between science and industry [6-10].
To grow agriculture of butter bean in our country there is a need to make complex investigations of breeds and make the offer of growing technology of butter bean taking into an account selectional value and biological specificity. The main idea of the research work conducted to determine the impact of environmental factors, heavy metals to product revenues and to make complex investigations to morphological and anatomical structure of soybean, it`s agricultural value. 29

Was conducted pot experiments using soybean, which has been considered an indicator plant, to study the effects of EDTA and EDDS on heavy metals' activation, and on the soybean. The study results indicated that EDDS decreased the chlorophyll content of the leaves and in-creased the malondialdehyde (MDA) content of the soybean. EDTA also decreased the chloro-phyll content of the leaves. EDDS had a strong influence on activating Cu (2583-8900-fold) and Zn. The addition of 5mmol kg(-1) of EDDS markedly increased the uptake of metals. Com-pared with the control, EDDS increased the Cu uptake (100-205-fold). EDTA greatly increased the activation of heavy metals; it also increased Cu uptake in a concentration-dependent man-ner. EDTA also increased the biological concentration factor (BCF) and the transfer factor (TF) in a concentration-dependent manner. The BCF and the TF reached maximum levels when 5mmol kg(-1) EDDS was applied to the pots [11].
The black soybean (Glycine max (L.) Men.) native to China contains rich protein, fat and vitamins. A total of 24 trace elements in black bean from Zhejiang, Heilongjiang, Hebei, Inner Mongolia, Henan, Hainan and Fujian provinces of China were determined by ICP-MS and AAS. Black beans were found to contain beneficial trace elements such as K, Mg, Ca, Zn, Fe and Mn for human health,. The heavy metal concentration in black beans are much low, which proves that black bean is a safe food. The qualities of black beans from the north provinces are higher than south provinces [12].
Were examined the growth response of 23 selected soybean cultivars to various lead con-centrations and also assessed their tolerance to lead. Variations in uptake, enrichment, and trans-location of lead among these cultivars were studied to screen out soybean Pb-PSCs. The results indicated that the seed Pb concentrations under three Pb treatments (500, 1,000, and 2,000 mg kg(-1)) varied significantly ($P < 0.05$), with average values of 0.20, 0.25, and 0.33 mg kg(-1), respectively. Cultivars Shennong 6, Shennong 8, Tiefeng 29, Tiefeng 37, Ji 1005, Liaodou 15, and Suke 1 were found to fit the criteria for Pb-PSCs. The seeds of these seven cultivars were further assessed for interactions between Pb and other mineral nutrient elements such as Ca, Cu, Fe, Mg, Mn, and Zn. High lead concentration in soil was found to inhibit the uptake of Ca, Cu, Fe, Mg, and Zn. Furthermore, Mn accumulation was found to be enhanced in the seeds of all of the seven Pb-PSCs in response to high Pb concentration [13].
A field study was carried out in the vicinity of a former battery recycling plant, with heavy metal content (Pb and Zn), the toxicological risk of seed consumption of soybean crops [Gly-cine Max (L.) Merr.] grown on these soils and their relation with seed quality being evaluated. The concentrations of Pb and Zn in soybeans (roots, stems, pods and seeds) and in top soils were investigated and their potential risk to the health of consumers was estimated. Further-more, quality-related seed parameters (standard germination test, tetrazolium test, biomass and weight of 1000 seeds) were obtained. The results show that the concentrations of Pb in soybeans at all sites (controls and close to the smelter) were above the maximum permitted levels. Seed quality decreased as the lead concentration increased in seeds from sites near to the former battery recycling plant. Moreover, the greatest accumulation of Zn in seeds was found at sites with high concentrations of Pb in soils. Taking into account these findings, future studies need to be performed in order to evaluate the parameters influencing the mobility and bioavailability of toxic metals in agricultural soils, with the purpose of not only assessing the current state of crops in terms of food security but also evaluating possible soil remediation techniques [14].
The aim of the research work: Investigate the impact of heavy metal Zn to anatomical structure of soybean.
Materials and methods: Subject of study: Adapted to the growth in the south-eastern Kazakhstan, in the early and mid-ripening varieties: Variety Zhansaya is considered as an object of study. Phenological observations to the growth and development of plant was carried out in a laboratory conditions. In laboratory conditions were made phenocontrol from the seeding until the sprouts completely thrived. The case where added heavy metal Zn and controlling variant germinated 10 plant duplicated three times for morphological and anatomical researches made 30

fixation to each variant by the Strasbourg Fleming method (1:1:1; water: glycerin: alcohol). Anatomical shapes were made by hand and MZP-01 microtome. Biometric measurements and photos carried out with the help of image microscope MCX100.

The results of the research: Investigated morphological and anatomical structure of sort Zhansaya grown soybean in variant where added heavy metal Zn 0.05% 2 ml biosoil and in controlling variant without heavy metal in clean biosoil, observation showed that at 1st variant where added heavy metal morphological index had high results, reached a length of 18 cm, at controlling variant 12 cm. At variant where added heavy metal developed true stem, at controlling variant were grown only hypocotyl and epicotyc. Leaves of first pair 4 cm were same at two variants, at the variant with heavy metals the number of higher leaves were higher.

During the investigation of hypocotyl`s anatomical structure of the Zhansaya sort the surface of the cells of the epidermis hypocotyl was the cuticly, cells well-developed at the primary cortex, indefinite black things were seen clearly. Two largest conducting bundle were at two sides of hypocotyl were located in the primary cortex, xylem developed better than the phloem. Core pith parenchimal cells are colorless thin bark, there are black things at the cell bark, picture-1.

Picture 1- Hypocotyl`s horizontal section , controlling variant

Notes: 1-epidermis; 2-primary cortex; 3- parenchyma;4-phloem; 5-xylem

Picture 2 – Hypocotyl`s horizontal shape, the variant with Zn

Notes: 1-epidermis; 2- trichome; 3-primary cortex; 4-conducting bundle; 5- parenchyma

While investigating the sort Zhansaya`s hypocotyl`s anatomical structures under the conditions where added Zn noticed that at hypocotyl`s epidermis trichome was developed, epidermis cells were with hard cuticles, cells were collapsed a little bit at primary cortex, indefinite black things were seen clearly. Conductive texture whole bundless structured, xylem developed better than phloem. Parenchymal cells are colorless thin shelled, on the cells shell there are some black things. Its middle part became hole (2 - picture). 31

0
1000
2000
3000

Anatomycal indexes of soybean`s hypocotyl, mkm

Controlling variant
The variant with Zn

Picture 3 - soybean hypocotyl`s comparative anatomical structure

At picture 3 during the comparison of anatomical structures, the thickness of primary cortex was thicker at controlling variant, conversely on case with Zn central cylinder increased. Conducting bundle жағдайда артқан at the variant where added Zn.

There given soybean`s epicotyl`s horizontal shape. At controlling variant the diameter of epycotyc is 2418 mkm, the thickness of primary cortex 122,11 mkm. The diameter of central cylinder is 2113,83 mkm, conducting bundle 485,34 mkm, xylem 153,10 mkm, phloem 318,06 mkm, 4,A, 5- pictures.

While defining from epicotyl`s horizontal shape its inner structure, on epicotyl`s epider-mis trichrome showed clearly. Epidermis cell`s outer cell shells became thicker on epicotyl. Primary cortex cells comprises from very small bulk cells, the number of largest conducting bundles is two, 13 conducting bundles very small bulk, on largest conducting bundles the num-ber of xylem rays is 11, and at small bundle comprises noticeable 1 xylem ray and 4-5 xylem tubes, one tube`s volume differenced by the bigness of another tubes 4,B, 6- pictures.

A B

Picture 4 – Epicotyl`s microscopic photo, A-controlling variant; B- Zn

2418
122,11
2113,83
485,34
153,1
318,06

Epicotyl`s anatomical structure,…

epicotyl`sdiameter
primarycortex
centralcilynder

Picture 5 – Epicotyl`s biometrics, controlling variant

3286,06
164,78
3050,1
638
295,15
289

Epicotyl`aatomical structure, the variant where we …

epicotyl`sdiameter
primarycortex
centralcylinder

Picture 6 –Epicotyl`s biometer, mkm, Zn

From the picture-7 at the variant with Zn there can be controlled the anatomical structure of the soybean stem. It`s defined that trichome well-developed also on stem. There indefinite dark things seen clearly on primary cortex at bark parenchyma cells. Cork cover at largest bundle on the top of phloem composed from sclerenchymal cells. After cambium xylem developed 5+6. We can see clearly 6-7 xylem tubes from each ray. It can be seen that smaller bundle goes to sclerenchymal cells. In one ray on xylem tube, total 3 controlled. Parenchyma cells are of transparent colored shelled and brittled. But at controlling variant stem did not grow up yet. At sort Zhansaya in variant where added Zn root is well-extensived, consisting of hypocotyl, epicotyl and real stem.

Picture 7 – Soybean stem, Zn 33

1668,34
1635,78
89,89
61,02
286,36
0
200
400
600
800
1000
1200
1400
1600
1800
central nerve
the upperepidermis
lowerepidermis
conductingbundle
Controlling
Zn

Picture 8 - *Morphometric indexes of leaves, mkm*

Two leaves developed after

seed fee comprises from circle formed and at same 4 cm width and length, during the investigation of anatomical structure, trichome developed at upper and lower epidermis. Upper epidermis cells are bigger than lower epidermis cells. Two conducting bundles located at the main nerve. Beneath the palisade mesophyll are the spongy mesophyll cells, which also perform photosynthesis. At central nerve colorless parenchymal cells are various form. At controlling variant, leaves are terry, upper epidermis 93,72 mkm, thickness of central nerve 1668,34 mkm, thickness of lower epidermis 71,22 mkm, in lower epidermis trichomes were well-developed, 8-picture. In case where added Zn, the thickness of upper epidermis 89,89 mkm, in largest conducting bundle 3 xylem rays in each 2-3 tubes, at central rays large tubes were developed. Phloem directed to lower epidermis. The volume of xylem bigger twice than phloem, thickness of central nerve

1635,78 mkm, conducting bundle 286,36 mkm, width 331,42 mkm, thickness of lower epiderm is 61,02 mkm, thickness of leave desk 693,66 мкм. To sum up, in case where added Zn mor

phometric indexes have high value revealed by the results of comparative investigations.

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