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The results of ecological security monitoring of agricultural plantings under high concentration of fluorides in soils of Poltava region

To estimate the environmental safety of food raw materials it is important to monitoring agricultural crops and soil in. Where they grow. The quality of the soil in Poltava region worsens every year. Moreover, most of them have high content of water-soluble (w/s) forms of fluoride, and it leads to its accumulation in plant material. The excess of fluoride in plants penalizes the functions of their life and reduces their productivity. Consumption of products made of such plant material is additional source of fluoride in a human body that contributes to development of pathologies such as fluorosis.

This work presents the results of monitoring of fluoride in soils and agricultural crops in some districts of Poltava region. There was established relationship between the concentration of water-soluble fluoride in the soil and their content in certain cultures. There was determined the necessity of creating a package of regulations to control the content of fluoride in plant material.

Keywords: environmental safety, fluoride, soil, plants, MPC (maximum permissible concentration), fluorosis.

The urgency of the research. The food security which is being done through the control of agrarian production, raw materials and finished product is complicadet many – layered process that urgently needs solving the problem of monitoring of soils pollution and growing from them plants further contamination.

Poltava region has constant tendency of agricultural soils worsening. Many types of soils are characterized by moving forms of fluorides, so they cause special danger because moving water-dissolving forms (fluorides of alkali metals) can be easily transferred to the tissues of plants[1, 12].

Under the conditions of modern agricultural production, the fluoride pollution takes place while using chemical fertilizers, pesticides, etc. The matter is that Poltava region soils have fluoride containing mineral soils (fluorapatites and others) which are washed out by ground waters especially by alkaline ones. Average fluoride content of these waters is 2,5 – 4,5 mg/l, but it should not exceed 1,5 mg/l [2, 59].

The above mentioned processes lead to constant fluoride accumulation in the whole chain of its migration.

Fluoride accumulation in soils leads to disastrous consequences connected with their characteristics changing due to chemical activity of fluoride acid to be created of solid and fluid fluoride combinations. Besides that, there is destruction of clay and other mineral complexes. In this research we proved that fermentative activity of microorganisms is reduced in soils with high fluoride content. Permissible concentration of fluoride for plants depends on soil and biological factors, type of plant, stage of its development, etc.

It is known that plants contamination by fluorides leads to [3, 314]:

1. Respiratory activity multifunction and lessening of oxygen consumption;
2. Lessening of chlorophyll concentration and reducing of nutrients assimilation (including starch);
3. Oppression of some ferments and catalysts functions;
4. Cells membranes damage;
5. Cell microbody metabolism change and nucleic acids destroying;
6. Synthesis of toxic fluoridorganic combination (south African plants, soya).

The result of the above mentioned processes is general plants slowing down and crop capacity reduction. The most dangerous factor of fluoride contamination is fluorides consumption by people and animals.

The effect of fluoride toxity with its stable form of fluoride anion upon human organism is rather well – known.

First toxity of fluoride anions is explained by formation of slightly soluble salts (fluorides) and complex combinations with cations Ca^{2+} and Mg^{2+} and other biogen elements – activators of ferment systems. As a result we have oppression of ferments, carbohydrates and fats exchange breaking, slowing down fatty acids oxidiration.

Second, fluorides are more chemically active than iodides and thus can be their competitor is in synthesis of thyroid gland hormones, they can influence upon its functions, causing certain diseases. Besides that, fluorides are allocated in various tissues of a human body unequally and being much akin to calcinable tissues, they are accumulated in them during the length of life [4, 87]. Endurable excessive presence of fluorides in a human body can cause pathological condition – fluorosis (specific colouring of teeth enamel), and malfunction of bone tissue mineralization (closure of pelvic bones, spine, ribs, thorax mobility limitation). Blood making organs are also under negative influence, there is irritation of red sprout of marrow and oppression of white one [5, 39].

According to the above mentioned, the aim of our research is estimation of the soils with different fluoride contamination level, their agricultural using,

determining the levels of the given element accumulation in agricultural plantings which are grown in Poltava region and strategically essential for Ukraine.

FINDING. Plants differently react upon high concentration of fluorides in the sol [6, 37]. For example, haricot, asparagus, cabbage, carrot, onion, osier are resisting to fluoride contamination and corn, parsley, gladiolus, apricot, pine-tree are e chose the plantings for the research which prevail in Poltava region: grain – crops, corn, soy, sunflower, sugar beet.

Soils and raw materials tests were conducted at the districts with increased fluoride content in water [2, 60]. They are Karlivka District, Mashivka District, Chiutove District, Shyshaky District, Velyka – Bagachka District. Among the tested soils there prevailed chernozem soils deep midhumic. Selection of tests for the analysis of fluorides was conducted according to valid State Standard 17.4.4.02-84 and State Standard of Ukraine 335596. Chemical analytical research was conducted at the "Poltavastandartmetrologia" and at the chair of Poltava University of Economics and Trade.

To define quantitative gross content of fluoride and water – soluble fluoride in soils and plants we should use potentiomertric method. To define gross fluoride in soil, the tests were first fritted water-soluble fluoride was extracted by extraction method. To define fluorides in plants the tests were first incinerated [7, 473].

Tolerance concentration in soils for gross content of all the fluoride forms is not reglamented by normative documents, but due to some sources [9,79] it is about 330 mg/kg and tolerance concentration for water – soluble forms must not outdo 10 mg/kg [8,3].

According to the research results (table 1), soils of the researched territories have overdone tolerance concentration is in Mashivka District (in 3 times) and Karlivka District (in 4 times).

As a result, the majority of agricultural plantings that grow at those particular soils have fluoride content.

So in corn their content outdoes the norm in 4-5 times, in barley in 3 times, in sugar beet in 7 times, in soy in 4-5 times. It is known that fluoride consumption due to consumption of precessed products will outdo the day need (1-4 mg.).

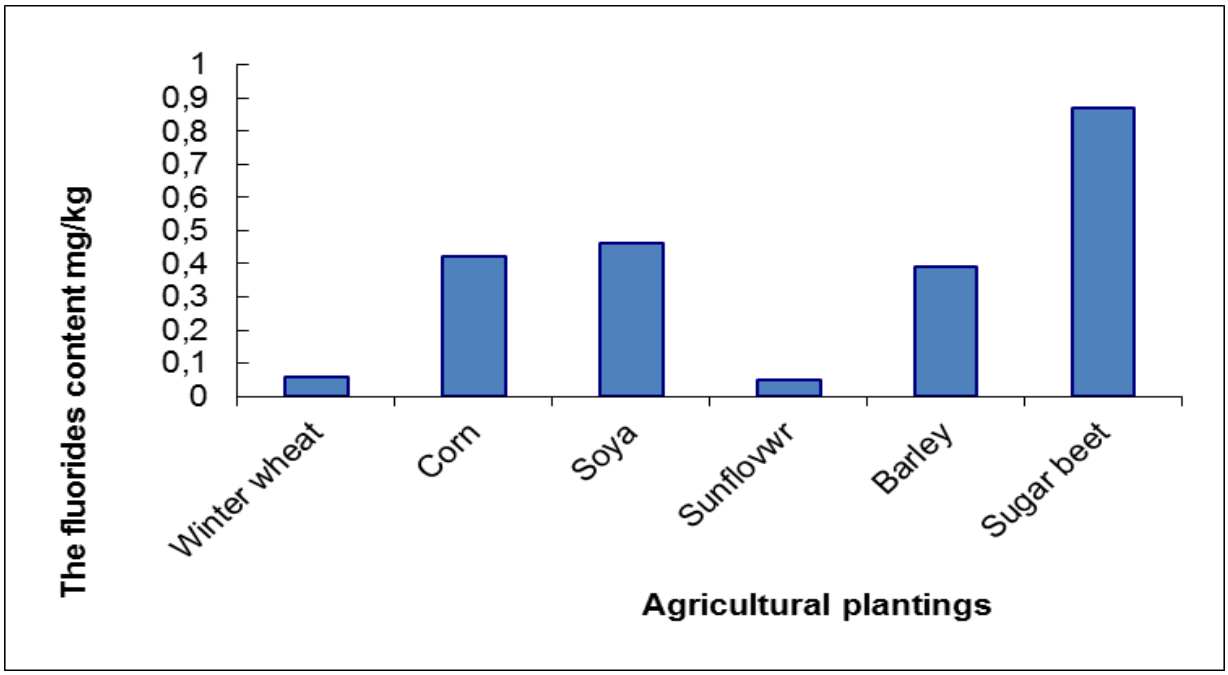
Content of fluorides in straw in the majority of the researched plantings (wheat, corn, barley) does not exceed tolerance concentration or is at the margin (soya) but straw of sunflower has exceeded content.

Table 1 – The results of research of fluorides content in soils agricultural plantings for some districts of Poltava region

Name for district	Content of gross fluoride in soil mg/kg	Tolerance concentration of gross fluoride in soil l mg/kg	Content of water-soluble fluoride in soil mg/kg	Tolerance concentration of water-soluble fluoride in soil mg/kg	Agricultural plantings	Content of gross fluoride mg/kg
Mashivka District	134,5	330,0	40,5	10	*Winter wheat:*	
					grain	2,50
					straw	8,80
	134,0		26,0		*Corn:*	
					grain	11,06
					straw	12,49
	134,2		26,2		*Soya:*	
					grain	12,13
					straw	15,57
Karlivka District	119,5		40,4		*Sunflower:*	
					grain	2,00
					straw	17,46
Chiutove District	181,5		20,3		*Barley:*	
					grain	7,76
					straw	11,65
Shyshaky District	68,9		22,4		*Sugar beet*	19,48
V.-Bagachka District	102,3		27,3		*Corn:*	
					grain	13,48

The main danger is while consuming the plants polluted by fluorides which turn assimilated from soil or air inorganic fluoride combinations into organic ones to be much more contaminant for a human being. According to the data [3,316] organic fluoride combinations, extracted from soya, are in 500 times more toxic than inorganic fluoride combinations.

The quantity of fluoride consumed by plant from soil certainly depends on soil peculiarity, anatomy and physiology of plant itself. We can see certain dependence between concentration of water-soluble fluorides in soil and their content in some plantings. For example 1 mg/kg of water-soluble fluorides in soil are 0,47 mg/kg fluorides in corn grain (picture 1)



Picture 1- Number of fluorides in agricultural plantings is upon 1mg/kg soil fluorides.

Defining this dependence permits us according to the soil analysis results for water soluble fluorides content find possible contamination of plants raw materials which grow at the given territory.

CONCLUSIONS.

The results of conducted research permit to substantiate scientifically the necessity of state (regional) standards development to control plant raw material of geochemical provinces for fluorides content and the recommendations as for secure and the most rational usage of soils with different level of fluorides pollution in agriculture.

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