

## Normative quality factors of grain of winter wheat on black earth in conditions of Forest-steppe and Steppe

M. Lisovyi,

Doctor of Agricultural Sciences

National Scientific Center "Institute of Soil Science and Agrochemistry named after O.N. Sokolovsky»

**The purpose.** To determine influence of natural fertility of black earth of different types and artificial fertilizers on protein and gluten content and vitreousness of grain of winter wheat in conditions of Forest-steppe and Steppe. **Methods.** Mathematical-and-statistical analysis of data of field experiments with fertilizers. **Results.** Normative quality factors of grain of wheat for the basic types of black earth and under condition of application of artificial fertilizers are specified. The skeleton map of the content of gluten in grain of winter wheat of in Ukraine is made. **Conclusions.** Quality of grain of winter wheat depends on fertility of different types of black earth and optimum doses of artificial fertilizers.

**Key words:** winter wheat, protein, gluten, vitreousness, black earth, fertilizer, skeleton map.

Winter wheat is one of the important food crops. The grain is used on the domestic market and also exported to foreign countries. In order to increase the export capacity of the country, it is not enough to enlarge the crop area of wheat, it is necessary to develop new scientific approaches to improving the quality of grain, that depends significantly on weather and climatic conditions, especially the conditions of soil moisture. Therefore, it is important to spread crops on the territory of Ukraine, taking into account natural zoning. The second important factor is the soil conditions, which also influence on the formation of grain quality [1, 2]. It is important to point at the fact that the quality of winter wheat grain, grown on the black earths (chernozem) of Ukraine, are higher as to compare to grain grown on other soils [3]. There are different types of chernozem. According to the morphological and genetic structure of the soil in the forest-steppe, chernozem is of two types: podzolized and typical; in the steppe - chernozems are ordinary and southern. Each of the types of chernozems is characterized by its fertility indices and peculiarities of climatic conditions for growing crops [4]. Therefore, their impact on the quality of the grain will be different. The third important factor in improving the quality of wheat is mineral fertilizers, the effect of which was studied by many local and foreign researchers [5 - 7, 10].

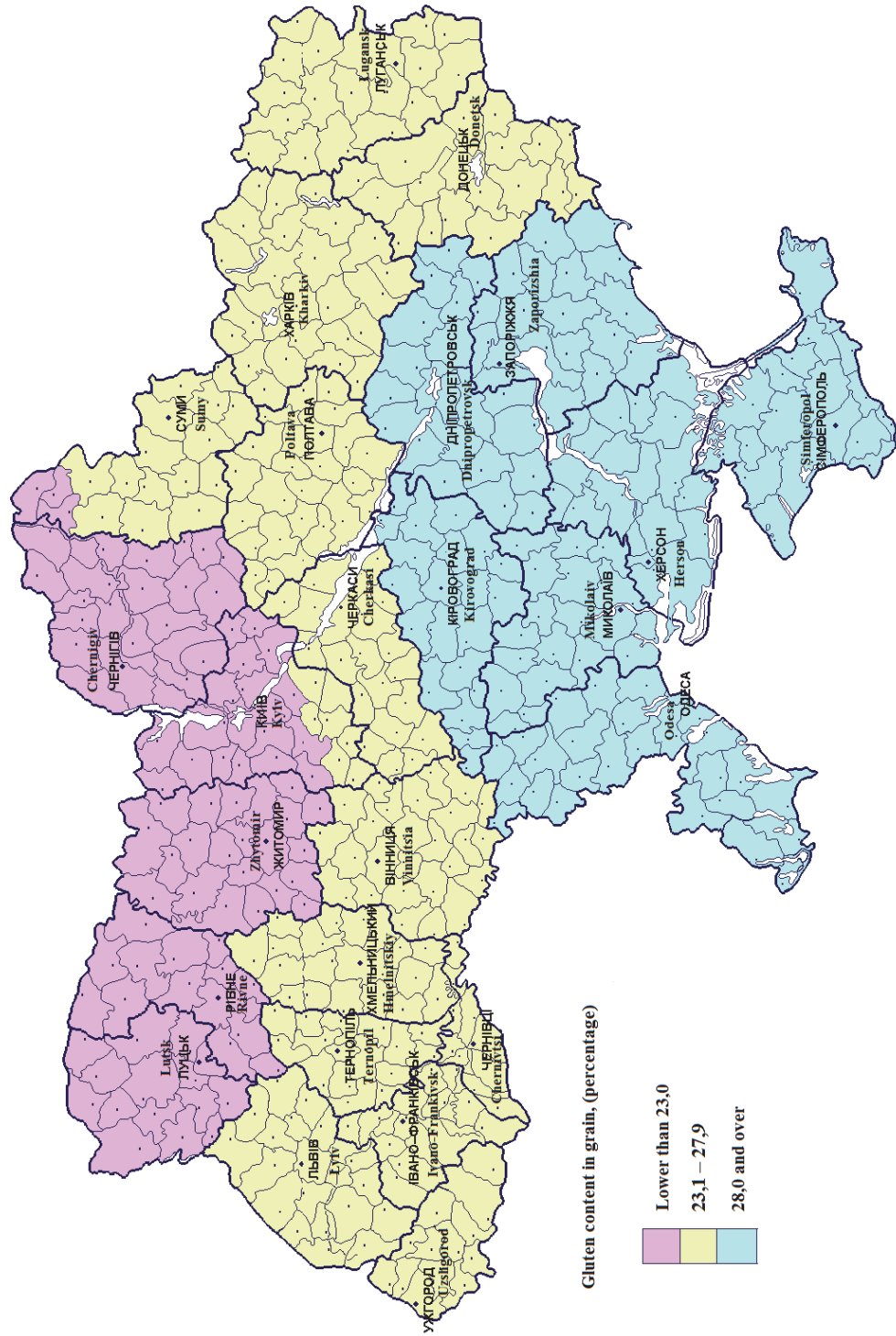
**The purpose of the research** is to determine the effect of natural fertility of various types of chernozem and mineral fertilizers on the protein content, gluten and vitreous appearance of winter wheat grain grown in forest-steppe and steppe zones.

**Research methodology.** To develop normative indicators of winter wheat grain quality, it is important to maintain and regularly update a relational database of field experiments with fertilizers that are carried out on the chernozem of forest-steppe and steppe zones. For each type of chernozem, samples of the contents of the protein, gluten and vitreous are formed. According to the results of the analysis of the correspondence of the data to the normal distribution of each sample (Shapiro-Ulyka criterion was applied) it was determined that the data distribution was significantly different from the normal one. Therefore, median is chosen for the central tendency of the values of the indicators, and for the variability of the indicator being studied, - the quantum scale (the difference between the upper and lower quartiles). In order to control the compliance of the data with the allowable value of the indicators, their minimum and maximum values are determined [8, 9]. The calculations were conducted using the licensed EPP STATISTICA 10 [9, 10] and the SUBD MS Visual FoxPro Pro 9.0 .

**Research results.** Normative indicators of protein content in winter wheat grains are: on chernozem podzolized - 11,0%, chernozem typical - 11,3, chernozem ordinary - 11,9, chernozem southern - 12,6% (table). The application of mineral fertilizers increases the content of protein in wheat grains on the chernozems of the forest-steppe to 13.7%, and the black soil of the Steppe - up to 14.2%.

**Normative indicators of winter wheat grain quality ( based on results of field tests with the application of the fertilizers)**

Soil	Quality factors	Natural soil fertility					Application of mineral fertilizers						
		Value of the indicators, %	Range of indicators, %				Number of samples	Value of the indicators, %	Range of indicators, %				Number of samples
			Lower quartiles	Upper quartiles	Lowest indicators	Highest indicators			Lower quartiles	Upper quartiles	Lowest indicators	Highest indicators	
Chernozem													
podzolized	protein	11,0	10,0	12,4	7,6	19,2	221	13,7	12,8	14,3	10,0	18,5	12
typical		11,3	10,2	12,7	7,7	18,7	474	13,4	11,4	14,1	9,6	17,5	40
ordinary		11,9	10,0	12,8	7,6	17,2	113	13,7	11,5	14,6	9,4	16,1	18
southern		12,6	10,7	14,0	8,0	17,1	114	14,2	12,8	15,9	8,1	18,7	56
podzolized	gluten	23,0	19,8	26,7	13,6	33,4	104	29,0	22,0	30,0	20,4	33,1	9
typical		26,2	22,5	30,0	13,5	39,9	358	30,0	29,6	35,7	20,0	36,8	14
ordinary		28,1	24,4	32,3	15,1	38,2	102	30,6	25,0	34,60	18,3	38,5	50
southern		28,0	24,2	30,3	13,9	37,4	116	32,6	26,0	36,6	19,6	39,7	19
podzolized	Vitreousness	61,0	52,4	89,0	40,0	96,0	62	62	55,5	69,0	41,0	93,0	9
typical		68,0	52,0	81,0	40,0	98,0	232	80	69,0	86,0	48,0	98,0	22
ordinary		75,0	60,0	88,5	40,0	97,0	89	93	87,0	97,0	47,0	98,0	11
southern		79,0	62,2	87,5	42,2	98,0	97	91	82,3	93,2	60,6	99,0	11



Gluten content in grain, (percentage)

- Lower than 23,0
- 23,1 – 27,9
- 28,0 and over

Picture – Skeleton map of gluten content in winter wheat grain grown in Ukraine.

Normative indicators of gluten content in winter wheat grains also increase from 23.0% on chernozems podzolized to 28.1% on chernozems southern. The content of gluten in grains is significantly affected by the weather conditions of the steppe zone. The addition of mineral fertilizers also increases the content of gluten from 29.0% in chernozem podzolized to 32.6% - in chernozem southern.

The vitreousness content in wheat grain varies by type of black earth is 61 - 79%. The extraction of mineral fertilizers increases the vitreousness in the forest-steppe to 62% on podzolized chernozem and up to 80% on typical chernozem; on soils of the Steppe - up to 91-93%.

The spatial pattern of gluten content in winter wheat grains on the territory of Ukraine is established (figure). Low content of gluten in winter wheat grains grown in the Polissya zone (up to 23%), the average (23.1 - 27.9%) - forest-steppe, high (28% and more) - in the steppe zone (see picture).

### **Conclusions**

In the conditions of the forest-steppe on the main types of chernozem, the normative indicators of the content of protein in winter wheat are: on podzolized chernozem - 11,0%, of chernozem typical - 11,3, in conditions of the steppe on chernozem ordinary - 11,9, chernozem southern - 12,6 ; The content of gluten is 23.0%, 26.2; 28.1 and 28.0%, vitreousness - 61%; 68; 75 and 79%. The introduction of mineral fertilizers increases the quality of winter wheat grains grown on chernozem of the forest-steppe and the steppe zones.

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