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SPECIFIC MANIFESTATIONS OF ENZYMOMYCOTIC DEPLETION OF GRAIN ON CROP LOSSES

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Background. Enzymomycotic depletion of grain leads to a significant decrease in the dry matter mass of the grain, as the intensity of respiration increases, protein substances break down, enzymes (in particular, α-amylase) pass from the adsorbed form to the water-soluble one, and their activity increases sharply. One of the consequences of this is the intensive amylolysis of starch, which means a significant deterioration in the technological indicators of the quality of grain and seeds.

Materials and Methods. This study gives a thorough description of the process of enzymomycotic depletion of grain of soft winter wheat (*Triticum aestivum* L.), sowing rye (*Secale cereale* L.), winter triticale (*Triticosecale* Witt.) depending on abiotic factors and the sources of resistance to ear diseases 4, 8, 12 days after the onset of full ripeness in the conditions of the western forest-steppe of Ukraine (2019–2021). Research methods – general scientific, field, measurement and weight, mathematical and statistical.

Results and Discussion. According to the obtained results, the dependence of enzymomycotic depletion of grain on abiotic factors was established. The development of ear diseases depended both on weather factors and on the ecological plasticity of the cultivar. The highest percentage of the distribution of ear sepsoria was observed on the 12th day after the onset of full ripeness: wheat – 3.3 %, rye – 2.4 %, triticale – 1.9 %, fusarium, respectively 2.4 %, 1.9 %, 1 %, 8 %. The loss of dry matter in the weight of 1000 grains depended on the ecotype of the cultivar and the duration of the grain standing time 4, 8, and 12 days after full ripeness.

Conclusion. The following cultivars were most resistant to EMDG: Oberih Myronivsky (wheat), Kobza (rye), Obrij Myronivsky (triticale); their base seed production profitability rates being 75.1 %, 116.6 %, and 146.8 %, respectively. The results of the study can be used in the selection of varieties of winter grain crops resistant to enzymomycotic grain depletion for the western forest-steppe and Polissya zones of Ukraine, where breeding work on these crops is not carried out and agricultural producers purchase seeds of new varieties from the originating institutions of the central forest-steppe to introduce them into production.

Keywords: culture, cultivar, weather factors, diseases, productivity, weight loss of 1000 grains, profitability

INTRODUCTION

One of the reasons for obtaining low yields of grain crops and losses during harvesting are abiotic factors. They can lead to annual 3–6-million-ton grain losses in Ukraine in unfavorable years (Lyubich, 2017; Bazalii *et al.*, 2018; Markovska & Hrechishkina, 2020). The most harmful diseases of plants and ears affect the biochemical processes in the plant and grain. The first information about the leaching of mineral compounds from plants by rainwater is found at the beginning of the 19-th century and continues to interest researchers to this day (Bilovus, 2016; Markovska *et al.*, 2018; Pohorila *et al.*, 2019).

Large yield losses are associated with enzymomycotic depletion if runoff process occurs during the ripening and harvesting of grain, in conditions of humid weather, falling dew and fog. It is often noted that under such conditions, puny, powdery spots, or sometimes a pink bloom and a black germ appear on grain, which negatively affects its technological and sowing qualities. Rain water leaches soluble carbohydrates from the endosperm, which were formed in the early stages of starch accumulation, with an increase in the consumption of carbohydrates for plant respiration (Popov *et al.*, 2016; Voloshchuk *et al.*, 2018).

During prolonged rains, not only carbohydrates are spent, but also nitrogenous and mineral substances. Under the action of enzymes, proteins and carbohydrates are uncoupled at the first stage, and at high humidity, sugars and nitrogenous substances are released from the grain. With the intensive development of the process, ears and grains become sweetish in taste (honey dew) (Baturevich & Burdenyuk-Tarasevich 2007; Kuleshov & Bilyk, 2014; Chernytskyi, 2012). At the same time, respiration significantly increases in the grain, additional moisture is absorbed, and the processes of dissolution and oxidation intensify, which in 1–3 days can lead to a significant weight loss, deterioration of sowing, technological and fodder qualities. The second stage is characterized by the colonization of ears and grain with fungi, which appear as black dots, or spots of various shapes and sizes. With further passage of the process, they acquire a solid black, less often pink-white mold on the grain and ear. Various toxins can also accumulate in such grain, which should be taken into account when determining the possibility of using this grain for food and feed purposes (Sheludko *et al.*, 2012; Borzykh, 2015).

The researchers claim that the total loss of dry matter in the winter wheat grain after intense rains can reach 20–25 %, the starch content is reduced by 2–10 %, the respiration rate increases by 8–10 %. Yield losses from enzymomycotic depletion of grain (EMDG) range from 0.29 to 1.0 t ha^{-1}, however, the harmfulness factor of grain runoff can reach 60 %. Combined with strong lodging of plants, losses increase by 4–5 times, and in the case of grain overstay "on the root" – by 2.0–2.5 times (Khakhula *et al.*, 2013; Vorobyova, 2016; Vashchenko & Nazarenko, 2014).

Carbohydrate-protein depletion of grain should be considered as an abiotic stress determined at the level of the organism as a result of a violation of the proportions between the vegetative and reproductive parts of plants, that is, a violation of the source-sink relationship (SSR) caused by inhibition of the outflow of assimilates from the flag leaf to the ear (Golyk & Kuzmenko, 2020).

The problem of selecting the cultivar of grain crops for the western forest-steppe zone is very important and at the same time difficult, since it is characterized by a wide diversity of growing conditions. Under such conditions, one cultivar, even with a wide adaptive potential, is not able to provide a stable grain harvest. In different zones of Ukraine, most of the studies on the impact of EMDG on the level of yield and technological properties are devoted to the quality of grain, while insufficient attention is paid to the biological properties of seeds. Namely, high-quality seeds are the carrier of genetic information, the key to preserving the planet's biodiversity, food and energy security of mankind, the economic efficiency of growing crops, an export-oriented product with a significant share in the world market (Voloshchuk *et al.*, 2012; Voloshchuk & Vorobyova, 2011).

The purpose of our research was to identify sources of resistance of such winter crops as soft wheat, rye, and triticale to grain depletion by enzymomycosis and provide economic justification for growing cultivars of different ecotypes resistant to this phenomenon.

MATERIALS AND METHODS

Field experiments were carried out in the crop rotation of the Seed Department of the Institute of Agriculture of the Carpathian Region of the National Academy of Sciences during 2019–2021.

The following grain crop cultivars were the object of this research: soft winter wheat – Vodogray Bilotserkivsky, Oberih Myronivsky, Mudrist Odeska; winter sowing rye – Knyazhe, Kobza, Kharkivyanka; winter triticale – Markiyan, Molfar, Obrij Myronivsky.

Characteristics of the soil of the experimental plots. The soil of the experimental plots is a gray forest soil, superficially gleyed, light loamy, characterized by the following indicators: humus content (according to Tyurin) – 1.7 %, the amount of absorbed bases – 13.7 meq per 100 g of soil, alkaline available nitrogen (according to Kornfield) – 89.6 mg kg^{-1} of soil, phosphorus and potassium (according to Kirsanov), 69.5 and 68.0 mg kg^{-1} of soil, respectively. Beyond the gradation, such a soil has a very low supply of nitrogen, a medium supply of phosphorus, and a low supply of potassium. The reaction of the soil solution (pH salt – 5.4) is slightly acidic.

Agrotechnics of cultivation – generally accepted for crops in this zone. The predecessor was winter rapeseed. The seeding rates for winter crops were as follows: 5.5 million viable seeds ha^{-1} – wheat, 5.0 million viable seeds ha^{-1} – rye, 4.5 million viable seeds ha^{-1} – triticale. The sowing time was optimal (20–25.09 – rye, triticale; 25.09–01.10 – wheat). Seed protection included vitavax 200 FF, 3 l t^{-1}; plants – herbicides: roundup, 4.0 l ha^{-1}; granstar, 75 % aqueous solution, 0.025 kg ha^{-1}; fungicide: falcon Dou, emulsion concentrate, 0.6 l ha^{-1}. Mineral fertilizers were applied before sowing. The wheat, rye, and triticale plants were nourished considering the stages of organogenesis according to the scale developed by the Biological Federal Institute for Agriculture and Forestry, the Federal Office for the Protection of New Plant Varieties and the Chemical Industry of Germany (German: Biologische Bundesanstalt für Land- und Forstwirtschaft, Bundessortenamt und der Chemischen Industrie – BBCH). It is based on the Zadox scale (1974), which takes into account the peculiarities of organogenesis in cereal crops. Fertilizers were applied during the organogenesis stages BBCH 20–22 (growth stage 2 – tillering, developmental phase – early tillering) and BBCH 30–32 (growth stage 3 – stem elongation, developmental phase – second node). The application rates for wheat and triticale were $N_{120}P_{90}K_{90}$, and for rye – $N_{60}P_{90}K_{90}$. The total area of the sowing plot was 60 m^2, and the accounting area was 50 m^2. The experiment was repeated in triplicate.

In the course of the research, the following was determined: resistance of cultivars to damage by plants and ear diseases, features of grain runoff depending on weather conditions, biological crop losses caused by EMDG (dry weight loss of 1000 seeds). Besides, economic assessment of the introduction of cultivars resistant to EMDG was made.

Determination of ear performance parameters. According to the method of G. K. Fursova *et al.* (2004), technical and harvesting ripeness of the grain was determined by the weight method (drying), which allows setting the timing of the onset of these stages with one-day accuracy. The analyses started from the milky ripeness stages and were repeated every three days. At the same time, in four to five typical places, plots were cut in a row 5–10 lake ears (40–50 inflorescences in total), the grain was threshed, mixed, and three samples of 100 pieces were taken. The samples were weighed, dried to an absolutely dry state, and the moisture content was calculated using formula 1:

$$A = \frac{(a-b)100}{a}, \quad (1)$$

A – humidity, %; *a* – the mass of raw grain; *b* – the mass of absolutely dry grain.

The weight of grain from one ear was determined by dividing the weight of the grain sheaf (in grams) by the number of productive stems of the crop under study; the mass of seeds – after cleaning on a Petkus laboratory machine.

The number of grains from one ear (X) was calculated by formula 2:

$$X = \frac{U \cdot 100}{F}, \quad (2)$$

U – average mass of grain from one ear, g; *F* – the mass of 1000 grains (in grams), determined from the average sample (without correction for moisture content).

Seed moisture was determined by pre-drying the grain (humidity above 20 %) and drying in a drying cabinet.

The weight of 1000 seeds (M) was determined by two weighings of 500 pieces, and the average weight was calculated with an accuracy of 0.1 g. If the weight of two samples differed from the average by more than 0.5 %, the third sample was weighed and calculated according to the following formula 3:

$$M = \frac{M_1(100-h)}{100-\text{Sh}}, \quad (3)$$

M_1 – mass of 1000 grains; g, h – grain moisture; %, Sh – standard grain moisture, 14 %.

Idetinfication of ear diseases. The development of diseases was determined according to methodological recommendations of S. O. Trybel *et al.* (2010) and V. P. Omelyuta *et al.* (1986) according to formula 4:

$$I = \frac{\sum(a \cdot b)100}{K \cdot B}, \quad (4)$$

I – disease development (in %); Σ (a·$в$) – the sum of the product obtained by multiplying the number of leaves by the corresponding score; K – the total number of counted leaves (healthy and damaged); B – the highest score on the accounting scale.

Harvest accounting. Biological productivity was determined by the number of plants per unit area (plant/ha), productive tillering (pcs/plant), number of grains per ear (pcs.) and weight of 1000 grains (g) recalculated at 14 % moisture content according the method by V. O. Ushkarenko *et al.* (2020).

Grain yield was determined by threshing each plot with a Sampo-130 combine and weighing.

The experimental results were processed and summarized using Microsoft Excel 2013 (Microsoft, Redmond, WA, USA). All the experimental data presented are the mean value of the deviation for the variants of the experiment. Data were processed using the analysis of variance method (ANOVA, Scheffe, Turkey) with a post-hoc test. Statistical significance ($p < 0.05$) of the results was determined by comparing the studied mean values of the sample to the control.

RESULTS AND DISCUSSION

Air temperature and precipitation during seed formation. Analyzing the weather conditions during the formation (seed ripening) period – from the second decade of June to the second decade of July, we found that daily temperatures exceeded the long-term average, and the amount of precipitation was higher, except for the second decade of July 2021 (**Fig. 1**, **2**).

In 2019, the sum of temperatures was higher by 9.6 °C, and the amount of precipitation was lower by 43.8 mm compared to the long-term averages of 68.1 °C and 128 mm. In 2020, the deviations of these indicators were respectively: 8.1 °C and 6.4 mm. The year 2021 was characterized by the highest sum of temperatures 16.4 °C and the amount of precipitation 43.4 mm.

The development of ear diseases. The spread of ear diseases over the years of research depended on weather factors that developed during the period of full ripeness – grain harvesting and the resistance of cultivars to these diseases (**Table 1**).

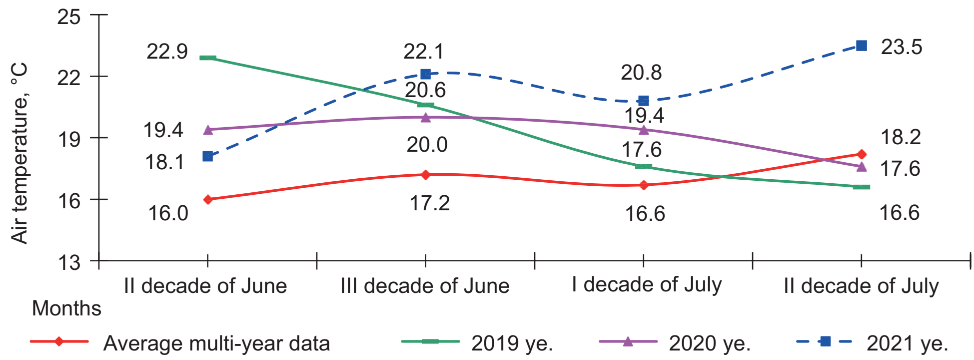

Fig. 1. Daily air temperature during the period of formation and ripening of seeds of winter crop cultivar (2019–2021)

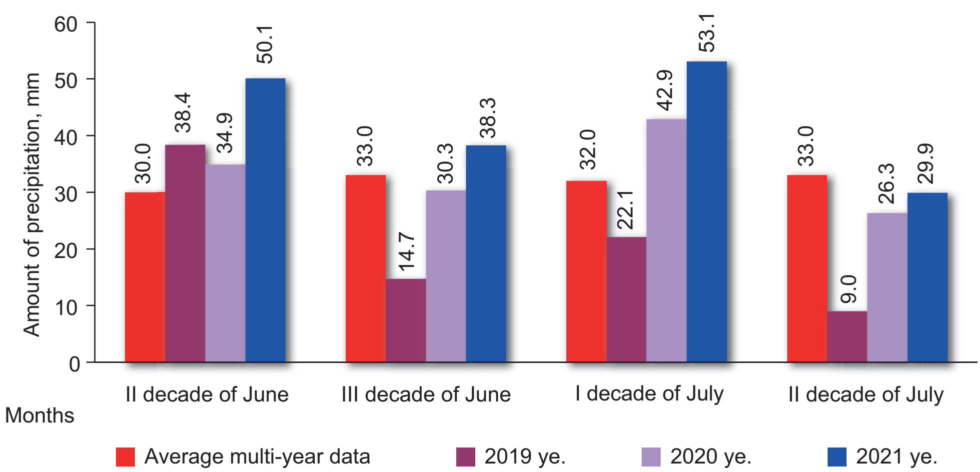

Fig. 2. The amount of precipitation during during the period of formation and ripening of seeds of winter crop cultivar (2019–2021)

The resistance of the studied cultivars to damage by ear diseases was different. A high average percentage of ear septoria development was observed on the 12-th day after the onset of full ripeness: 3.3 in wheat ($SSD_{0.05}$ = 0.25 %), 2.4 in rye ($SSD_{0.05}$ = 0.20 %), 1.9 triticale ($SSD_{0.05}$ = 0.29 %), and fusarium, respectively, 2.4; 1.9; 1.8 with $SSD_{0.05}$ = 0.26 %; 0.19 % and 0.28 %.

Seed yield. Over the years of research, the average yield of soft winter wheat varied from 3.86 t ha^{-1} (Mudrist Odeska) to 4.40 t ha^{-1} (Oberih Myronivsky); rye – Kharkivyanka (3.59 t ha^{-1}) – Kobza (3.90 t ha^{-1}); triticale – Markian (4.27 t ha^{-1}) – Obrij Myronivsky (4.59 t ha^{-1}) (**Fig. 3**). With $SSD_{0.05}$ = 0.17 t ha^{-1}, the difference between the triticale cultivars Molfar and Markian was significant and insignificant between Obrij Myronivsky and Markian. In rye (winter), an equivalent yield ($SSD_{0.05}$ = 0.29 t ha^{-1}) was provided by Kobza and Knyazhe cultivars and significantly lower by Kharkivyanka. No significant difference was observed in the productivity of winter wheat cultivars ($SSD_{0.05}$ = 0.11 t ha^{-1}).

Table 1. **Development of ear diseases in grain crops depending on varietal characteristics (2019–2021), %**

Cultivar	Ear diseases							
	septoria (*Septoria nodorum* Berk.)				fusarium (*Fusarium* Link.)			
	full ripeness phase	after full ripeness (days)			full ripeness phase	after full ripeness (days)		
		4	8	12		4	8	12
Soft wheat (winter)								
Vodogray Bilotserkivsky (control)	2.3	2.6	2.9	3.3	1.3	1.3	2.2	2.4
Oberih Myronivsky	1.9	2.2	2.5	2.9*	1.3	1.6	1.8	2.1*
Mudrist Odeska	2.2	2.5	3.0	3.6	1.8	2.0	2.5	2.7
Average	2.1	2.4	2.8	3.3	1.5	1.8	2.2	2.4
$SSD_{0.05}$	0.29	0.22	0.30	0.25	0.21	0.20	0.24	0.26
Rye (winter)								
Knyazhe (control)	1.2	1.5	2.0	2.2	0.9	1.1	1.5	1.8
Kobza	1.3	1.7	1.9	2.2*	1.0	1.3	1.5	1.8*
Kharkivyanka	1.7	1.9	2.4	2.8	1.1	1.2	1.7	2.0
Average	1.4	1.7	2.1	2.4	1.0	1.2	1.6	1.9
$SSD_{0.05}$	0.13	0.16	0.18	0.20	0.10	0.15	0.17	0.19
Triticale (winter)								
Markian (control)	1.0	1.4	1.8	2.2	0.9	1.2	1.7	2.1
Molfar	0.6	1.0	1.3	1.7*	0.8	1.0	1.3	1.7*
Obrij Myronivsky	0.7	1.0	1.4	1.8	0.7	1.0	1.3	1.7*
Average	0.8	1.1	1.5	1.9	0.8	1.1	1.4	1.8
$SSD_{0.05}$	0.27	0.30	0.25	0.29	0.10	0.12	0.23	0.28

Note: * – cultivar most resistant to EMDG

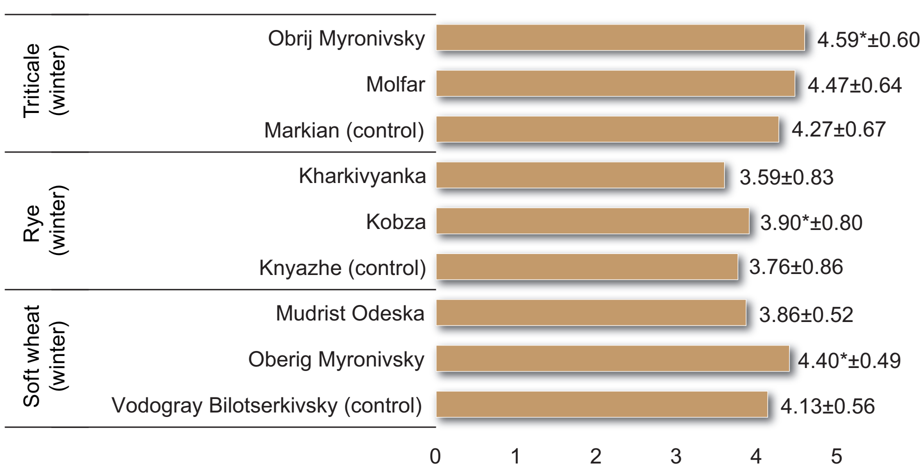

Fig. 3. Seed yield of winter crop cultivars (2019–2021), t ha^{-1}
Note: * – the most productive cultivars

Weight loss of 1000 seeds. Depending on the weather factors during the period of full ripeness, the duration of grain standing time "on the root", the crop type, the biological characteristics ability of the cultivar to respond to external conditions, the loss of absolute dry weight of 1000 seeds over the years of research was different (**Fig. 4**). The average indicator for winter wheat cultivars on the 4th day was 2.9 %, rye – 5.0, triticale – 3.25 %. On the 8th day they grew accordingly to 4.4%, 7.4 % and 4.7%, and on the 12th day – up to 6.0 %, 10.3 % and 6.6 %.

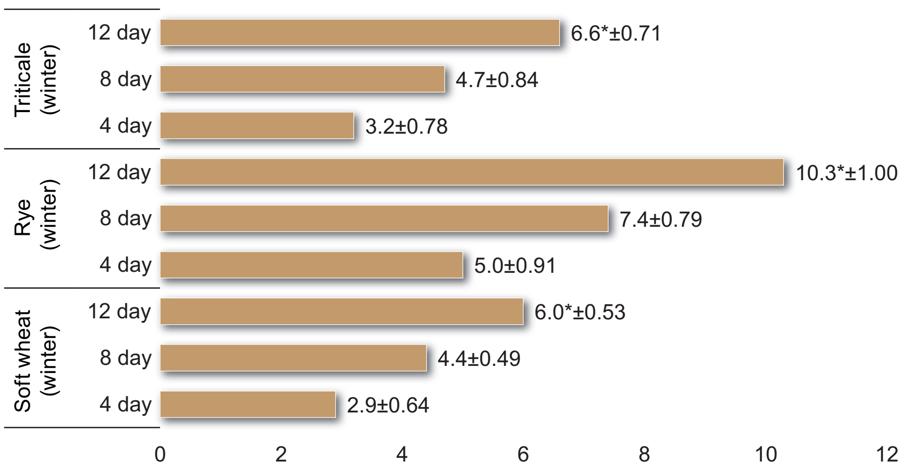

Fig. 4. Dynamics of weight loss of 1000 grains of winter crop cultivars after their full ripeness (2019–2021), %
Note: * – significantly higher weight loss of 1000 grains on day 12

The data of the statistical analysis confirm that the greatest losses from enzymomycotic depletion of grain of winter rye grain ($SSD_{0.05}$ = 0.52 %) were observed in the Kharkivyanka cultivar – 11.2 %, triticale Markian – 6.9 % ($SSD_{0.05}$ = 0.42 %), winter wheat Mudrist Odeska – 6.8 % ($SSD_{0.05}$ = 0.36 %).

Economic efficiency of growing cultivars resistant to EMDG. Cultivars of winter crops that were resistant to enzymomycotic depletion of grain ensured a high level of profitability in seed production (**Table 2**). The highest indicator in soft winter wheat was obtained from growing Oberih Myronivsky – 75.1 %, rye Kobza – 116.6 %, and triticale Obrij Myronivsky – 146.8 %.

In recent years, very little research has been devoted to enzymomycotic depletion of grain, since this phenomenon is typical of areas with excessive moisture. However, data obtained in the steppe zone (Derevenets-Shevchenko, 2013) show that with the development of saprophytic microflora when the grain reaches full ripeness, there is a shortage of crops, and technological qualities of the grain deteriorate. The cost of grain products decreases, and the cost of finishing grain standards rises. The infected grain undergoes biochemical decomposition even with a short-term increase in humidity during transportation and storage.

Under conditions of excessive moisture in the western forest-steppe zone (HTC 1.5–1.8), according to Vorobyova (2011), enzymomycotic grain depletion leads to significant yield losses – 0.08 t ha^{-1} (medium-late) – 0.75 t ha^{-1} (early ripe cultivars). The lowest coefficient of variation of seed yield losses (0.02) was characterized by mid-ripening cultivars Myronivska 65, Perlyna Lisostepu, Kryzhynka and mid-late cultivar Tsyganka (0.01).

Table 2. **Economic evaluation of growing grain crops depending on the resistance of the cultivar to enzymomycotic depletion of grain (2021)**

Cultivar	Seed yield, t ha^{-1}	The cost of sold seeds, thousand UAH	Cost per 1.0 ha, thousand UAH	Notional net profit, thousand UAH t^{-1}	Cost of production, thousand UAH t^{-1}	Profitability, %
Soft wheat (winter)						
Vodogray Bilotserkivsky (control)	3.49	33.9	20.5	13.4	5.9	65.4
Oberih Myronivsky	3.69	35.9	20.5	15.4	5.6	75.1*
Mudrist Odeska	3.10	30.1	20.5	9.6	6.6	46.8
Rye (winter)						
Knyazhe (control)	4.23	41.1	20.5	20.6	4.8	100.5
Kobza	4.57	44.4	20.5	23.9	4.5	116.6*
Kharkivyanka	4.07	39.6	20.5	19.1	5.0	93.2
Triticale (winter)						
Markian (control)	4.97	48.3	20.5	27.8	4.1	135.6
Molfar	5.14	50.0	20.5	29.5	4.0	143.9
Obrij Myronivsky	5.21	50.6	20.5	30.1	3.9	146.8*

Note: * – the highest profitability

Determining the varietal features of the yield formation of 24 cultivars of winter wheat, we revealed a significant influence of the weather conditions of the year on the weight of 1000 grains – 60 %, followed by varietal characteristics – 31 %, their interaction – 8 %, other factors – 1 %. In the phase of full ripeness, the weight of 1000 grains was high and amounted to 44.6 g for cultivars of the forest-steppe ecological type, and 40.3 g for the steppe ecological type, with a difference of 4.3 g. When harvesting winter wheat was delayed by 12 days, the losses reached 7.5 g % (forest-steppe ecotype) – 9.0 % (steppe). The yield difference by ecotype was 0.44 t/ha. The most resistant to enzymomycotic grain depletion (EMDG) were the following cultivars: Yuvilyar Myronivsky, Kolos Myronivshchyna, Benefis, Kraevyd, Lisova Pisnya (Voloshchuk *et al.*, 2020).

CONCLUSION

1. The main sources of resistance to enzymomycotic grain depletion of winter grain crops are: weather conditions that develop during the grain ripening and harvesting period (the 3rd decade of June – the 2nd decade of July), including a higher sum of effective temperatures and a lower level of precipitation compared to the average long-term data (521 °C and 98 mm); the duration of grain standing time "on the root"; the forest-steppe eco-friendly type, cultivar ripeness group, cultivar, seed coat color, weight of 1000 grains; stable group resistance of cultivars to diseases while maintaining high rates of a number of other economic characteristics.
2. It has been established that enzymomycotic grain depletion leads to significant yield losses. With the overstay of grain "on the root" from 4 to 12 days after the onset of full ripeness, the loss of dry matter of 1000 seeds increased in winter wheat from 2.5–3.3 % (day 4) to 3.7–5.0 % (8 day) and 5.3–6.8 % (day 12), in winter rye, respectively, from 4.6–5.6 % (day 4) to 6.5–8.3 % (day 8) and 9.3–11.2 % (day 12) and triticale from 3.1–3.3 % (day 4) to 4.4–5.0 % (day 8) and 6.4–6.9 % (day 12).
3. The cultivars most resistant to EMDG were: Oberih Myronivsky (wheat), Kobza (rye), Obrij Myronivsky (triticale), whose level of profitability of seed production was, respectively: 75.1 %, 116.6 % and 146.8 %.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest: The authors declare that the study was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization, [V.I.S.]; methodology, [V.O.]; validation, [V.I., H.V.]; formal analysis, [V.I., V.O., S.O., P.H., B.H.].; investigation, [H.V., I.U.]; resources, [V.I., V.O., H.V., M.O., K.O.]; data curation, [V.I., V.O., H.V., B.H., I.U., M.O., K.O.]; writing – review and editing, [V.I.]; visualization, [V.I., V.O., H.V., B.H., I.U., M.O., K.O.]; supervision, [V.O.]; project administration, [V.I.]; funding acquisition, [-].

All authors have read and agreed to the published version of the manuscript.

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ОСОБЛИВОСТІ СПЕЦИФІЧНИХ ПРОЯВІВ ЕНЗИМО-МІКОЗНОГО ВИСНАЖЕННЯ ЗЕРНА НА ВТРАТИ ВРОЖАЮ

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Обґрунтування. Ензимо-мікозне виснаження зерна призводить до значного зменшення маси сухої речовини зерна, оскільки підвищується інтенсивність дихання, розпадаються білкові речовини, ферменти (зокрема, α-амілаза) переходять з адсорбованої форми у водорозчинну, їхня активність різко зростає. Одним із наслідків цього є інтенсивний аміноліз крохмалю, що означає значне погіршення технологічних показників якості зерна та насіння.

Матеріали та методи. У цьому дослідженні обґрунтовано процес ензимо-мікозного виснаження зерна сортів пшениці м'якої озимої (*Triticum aestivum* L.), жита посівного (*Secale cereale* L.), тритикале озимого (*Triticosecale* Witt.) залежно від абіотичних чинників і встановлено джерела стійкості до хвороб колоса в умовах перестою зерна "на корені" упродовж 4, 8, 12 діб після настання повної стиглості в умовах Західного Лісостепу України (2019–2021 рр.). Методи досліджень – загальнонаукові, польові, вимірювально-вагові, математично-статистичні.

Результати і обговорення. На основі отриманих результатів встановлено залежність ензимо-мікозного виснаження зерна від абіотичних факторів. Розвиток захворювань колоса залежав як від погодних факторів, так і від екологічної пластичності сорту. Найбільший відсоток розповсюдження сепсоріозу колосу спостерігали на 12-ту добу від настання повної стиглості: пшениці – 3,3 %, жита – 2,4 %, тритикале – 1,9 %, фузаріозу, відповідно 2,4 %, 1,9 %, 1,8 %. Втрати сухої речовини у масі 1000 зерен залежали від екотипу сорту і тривалості простою зерна 4, 8, 12 діб після повної стиглості.

Висновки. Найстійкішими до ЕМВЗ були сорти: Оберіг Миронівський (пшениця), Кобза (жито), Обрій Миронівський (тритикале), за рентабельності базового насінництва відповідно 75,1 %, 116,6 % і 146,8 %. Результати дослідження можуть бути використані у процесі добору сортів озимих зернових культур, стійких до ензимо-мікозного виснаження зерна для зони Західного Лісостепу та Полісся України, де не ведеться селекційна робота по цих культурах і де сільськогосподарські виробники закуповують добазове насіння нових сортів в установах-оригінаторах Центрального Лісостепу, а навіть і Степу для впровадження їх у виробництво.

Ключові слова: культура, сорт, погодні чинники, хвороби, продуктивність, втрати маси 1000 зерен, рентабельність

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