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HULLED WHEATS' (*TRITICUM SPELTA*, *TRITICUM DICOCCUM*) GRAIN QUALITY, GERMINATION, AND VIABILITY CHARACTERISTICS

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Parameters of grain productivity, seed viability and quality of hulled winter wheat plants from two species (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) grown under Ukraine south steppe zone conditions were studied and compared with the same parameters determined for winter wheat and durum wheat cultivars (*T. aestivum* L., *T. durum* Desf.). It was shown that a spike seed productivity of both *T. spelta* L. landraces one of *T. dicoccum* Schrank Schuebl. landrace had no significant differences among themselves and was 35–45 % lower compared to studied cultivars. *T. spelta* L. and *T. dicoccum* Schrank Schuebl. seeds compared to wheat cultivars' seeds were characterized by higher dry gluten content, higher protein content and protein soluble fractions content. According to germination test results, all studied wheat samples from different species didn't show significant differences. Statistical differences among hulled wheat seed samples, seedlings biomorphology parameters and chlorophyll content in leaves were found. At the same time, both hulled wheat species had lower, compared with wheat cultivars, seed viability determined by Accelerated Aging test. It was shown, that hulled wheat samples with higher seed productivity parameters were also characterized by higher protein content, formed seedlings with better quality characteristics, and were more resistant to unfavorable conditions (100 % humidity, 37 °C temperature).

Keywords: *Triticum dicoccum* Schrank Schuebl., *Triticum spelta* L., seed quality, seedlings, accelerated aging, chlorophyll content.

INTRODUCTION

Two of the most common hulled wheat species are the tetraploid emmer (*Triticum dicoccum* Schrank Schuebl.) and the hexaploid spelt (*Triticum spelta* L.). In the last 20 years the hulled wheat species growing is again increasing for the higher feeding value, suitability for organic agriculture and as a genetic resource for selection.

The main characteristics of hulled wheat grain are the maintaining glumes adhered to the grain after threshing and the semi-brittle rachis [5]. Spelt has longer and laxer spikes, wider glumes, and glum shoulders than emmer [18]. It was shown that nutritional value of spelt wheat is higher compared to bread wheat. Spelt grain contains the main components which are necessary for human nutrition, such as sugars, proteins,

lipids, vitamins and minerals [2]. The spelt grains are flinty, with high protein content, and with medium wet gluten level [22]. Emmer also considered having high feeding value, but data are not as complete as data for spelt wheat [1].

Spelt and emmer are cultivated on many ecological farms in Poland, Spain, Germany and other European countries not only because of higher feeding value in comparison with common wheat, but also due to higher resistance to some environmental factors, especially low requirements for soil fertility and wet conditions. The productive efficiency of cereals depends on many site-specific factors, such as soil fertility, climate, management style. It is known that grain quality and nutritional value depend both on the growing conditions and on the species and variety [14].

It was shown that in the Eastern Steppe of Ukraine growing of spelt cultivars is impossible due to their low frost tolerance [17]. South of Odessa region is related to the Ukraine South Steppe zone and is characterized by drought conditions and high annual temperature which is unusual for spelt. According to the literature data [19] emmer is tolerant to drought and has high water-retaining holding capacity. Our previous data [21] showed that under Ukrainian South Steppe zone conditions spelt and emmer normally passed all development phases and matured later than commercial wheat cultivars. But quality and viability characteristics of spelt and emmer grain harvested in Odessa Steppe conditions haven't been studied enough yet.

So the aim of our work was to compare different landraces hulled wheat seed (*Triticum spelta* L. and *Triticum dicoccum* Schrank Schuebl.) productivity indicators under field conditions of Ukrainian south steppe zone and to study quality, germinability and viability characteristics of harvested grain in the laboratory conditions.

MATERIAL AND METHODS

Two spelt (*T. spelta* L. var. duhamelianum) and two emmer (*T. dicoccum* Schrank Schuebl var. rufum and var. dicoccum) landraces from The National Center for Plant Genetic Resources of Ukraine were studied. Studied hulled wheat landraces had different geographical origination. Catalogue numbers of spelt landraces were: UA 0300259 (Serbia), UA 0300101 (Sweden); emmer landraces: UA 0300164 (France), UA 0300087 (Spain). One commercial winter wheat (*T. aestivum* L. check cultivar (Selyanka) and one durum wheat (*T. durum* Desf. check cultivar (Perlyna) were also planted for comparison with hulled wheat seed productivity parameters and quality parameters. Selyanka and Perlyna cultivars were selected as those recommended for growing in the Steppe zone and are traditional for the Ukrainian South Steppe zone. Both these cultivars are in the catalogue of Plant Cultivars of Ukraine and characterized by high drought resistance and productivity. Parameters, obtained for emmer landraces in the tables were compared with parameters obtained for *T. durum* Desf. Perlyna cultivar; parameters, obtained for the spelt landraces in the tables were compared with parameters obtained for *T. aestivum* L. Selyanka cultivar as genetically homological wheat species.

The study was conducted during 2013–2014 at experimental fields of Plant Breeding and Genetics Institute – National Center of Seed and Cultivar Investigation (Odessa). In field experiments each landrace was planted in two replicates in a randomized complete block design. Wide-row sowing technique was used. Fertilization practices were standard for commercial wheat cultivars [23]. There were no applications of growth regulators. After plants reached maturity we studied morphometrical parameters of spikes and grain productivity characteristics and compared these data between studied species and landraces.

Wheat seeds from different species and cultivars harvested from plants at maturity were analyzed. A number of biochemical and technological parameters were tested: grain hardness, protein content, content of soluble in 1-isopropanol proteins and total dry gluten content. Protein content was determined by the Kjeldahl technique [10]. The content of dry gluten [11, 12], and grain hardness were determined with the infrared analyzer Inframatic (Perten Instruments, Sweden).

Harvested seeds after ripening were also tested for their germinability, seedlings were analyzed for biomorphological parameters, chlorophyll content ($a+b$) in leaves and accelerated aging test. All tests were performed under laboratory conditions. Seeds were germinated after-ripening during 7 days in Petri dishes at 24 °C. Then germinability and seedlings biomorphology were tested. Chlorophyll content ($a+b$) measured on the 10th day after germination in green parts of seedlings and was expressed in mg/g of fresh weight [16]. Accelerated aging test was provided as complex test for seed stress tolerance, viability and storage potential [6]. Tested seeds were placed into sterile boxes with relative humidity close to 100 % and transferred into the thermostat at +37 °C for 7 days. Seeds humidity was 30 % after 3 days of accelerated aging and didn't change any more. After seeds exposition during 7 days germinability and seedlings biomorphology was tested.

Laboratory experiments were conducted with three replicates ($n = 3$). The table shows the means and their standard deviations. Student test (t -test) was used to assess the statistical significance for certain parameters between different genotypes. Calculations were performed using standard software package Microsoft Excel 2010.

RESULTS AND DISCUSSION

Ukrainian South Steppe zone is related to Pontic steppes with temperate continental climate, severe aridity, and is characterized by low average annual rainfall, frequent draughts in the spring and autumn and high annual temperatures [23]. These conditions are unusual for spelt growing more related to cold and wet regions [4]. Field data showed that in the studied years under the climatic conditions of the Ukraine South Steppe region emmer and spelt normally passed all phenological phases of development. After plants gain their maturity a morphometrical parameters of spikes and grain productivity parameters were studied (Table 1).

In a large extent grain productivity depends on cultivar's or landrace's adaptive potential to weather conditions for crops growing. In literature a spelt and emmer are characterized as a crop with grain productivity 30–60 % lower compare with commercial bread wheat cultivars [13]. To assess a potential productivity of grain plants a spike density, seed productivity per spike and grain weight per spike must be taken into account. According to our results, spelt had longer spikes with lower density. Emmer landraces had higher indicators of spike density in comparison to winter wheat cultivar and had no significant differences with durum wheat.

Grain weight of all studied spelt landraces counted per spike was lower than that for check wheat cultivar (35 % for UA0300259 and 40 % for UA0300101) which is in agreement with literature data [22]. Emmer landraces were more heterogenic in their productivity characteristics: while UA 0300087 landrace's grain productivity wasn't lower than characteristics obtained for durum wheat, productivity of another studied landrace was 54 % lower.

Table 1. Spike's morphometrical parameters and productivity of hulled wheat species (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) plants and commercial wheat species (*T. aestivum* L., *T. durum* Desf.) plants grown under Ukrainian South Steppe zone conditions

Таблиця 1. Продуктивність і морфометричні параметри рослин видів плівчастих пшениць (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) та рослин комерційних видів пшениці (*T. aestivum* L., *T. durum* Desf.), вирощених за умов півдня степової зони України

Cultivar, landrace	Spike length, cm	Amount of spikes, psc.	Spike density, psc/cm	Amount of grains in main shoot spike	1000 grain weight, g	Grain weight in main shoot spike, g
<i>T. aestivum</i> L. (Selyanka)	8.6±0.3	17.0±1.1	1.90±0.05	44.0±2.5	38.7±3.2	1.81±0.07
<i>T. spelta</i> L. (UA 0300259)	16.9±0.8*	18.0±1.0	1.20±0.09*	32.0±5.0*	39.3±3.2	1.18±0.15*
<i>T. spelta</i> L. (UA 0300101)	14.2±1.2*	19.0±1.0*	1.50±0.05*	31.0±4.8*	36.1±4.0	1.09±0.07*
<i>T. durum</i> Desf. (Perlyna)	8.0±0.5	22.0±1.8*	2.80±0.08*	40.0±5.2	46.8±5.5	1.86±0.09
<i>T. dicoccum</i> (UA 0300164) var. <i>dicoccum</i>	7.6±1.0	20.3±0.8	2.70±0.07**	39.0±5.0	22.2±3.8*	0.86±0.06*
<i>T. dicoccum</i> (UA 0300087) var. <i>rufum</i>	12.3±1.2*	28.0±0.6*	2.30±0.07**	40.0±4.0	46.0±3.5	1.85±0.18

Comments: * – differences significant at $p \geq 0.95$: compared to *T. aestivum* (Selyanka) for *T. spelta* landraces; compared to *T. durum* (Perlyna) for *T. dicoccum* landraces.

Примітки: * – відмінності достовірні за $p \geq 0.95$: порівняно з *T. aestivum* (для зразків *T. spelta*); порівняно з *T. durum* (для зразків *T. dicoccum*).

So, studied spelt landraces didn't have statistical differences between spike's grain productivity and 1000 grain weight indicators. The highest indicators of spike grain productivity among emmer landraces were obtained for landrace UA 0300087 (*T. dicoccum* var. *rufum*), that also had two fold higher 1000 grain weight, in comparison with another tested landrace.

Probably one of the main reasons for the increasing planting of hulled wheat species is the high nutritional value of grain and different gluten composition as compare with commercial wheat cultivars. Among the disadvantages of emmer bread, is the fact that it is flatter and darker than spelt, whereas its structure is spongier. However, it is still unclear which bread emmer or spelt has higher nutritional and bakery value [1].

Since wheat end-use quality is strongly influenced by environment, especially as related to grain protein content, a grain yield of spelt, emmer, common wheat and durum wheat harvested in conditions of Ukrainian South Steppe zone were analyzed for grain hardness, protein content, content of soluble in 1-isopropanol proteins and dry gluten content (Table 2).

It is common to differentiate "soft" and "hard" hexaploid wheats and "very hard" durum wheat as three distinct qualitative classes. It is the single most important trait and end-use and technological utilization [15]. According to our results, spelt and emmer

had opposite characteristics of grain hardness. Whereas spelt grain hardness was close to durum wheat grain, grain of spelt wheat had lower characteristics of grain hardness, even compared with the soft winter wheat. It should be taking into account when we talk about end-use of grain flour.

Table 2. Technological parameters of hulled wheat species (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) grain and commercial wheat species (*T. aestivum* L., *T. durum* Desf.) grain harvested under Ukrainian South Steppe zone conditions

Таблиця 2. Технологічні показники якості зерна рослин видів піввчстих пшениць (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) і рослин комерційних видів пшениці (*T. aestivum* L., *T. durum* Desf.), вирощених за умов півдня степової зони України

Cultivar, landrace	Grain hardness, units	Protein content, %	PS in 1-isopropanol, % ¹⁾	Dry gluten content, %
<i>T. aestivum</i> L. (Selyanka)	28	12.9±0.3	31.1±0.5	7.8±1.2
<i>T. spelta</i> L. (UA 0300259)	11	18.2±0.2*	52.4±0.9*	13.9±1.2*
<i>T. spelta</i> L. (UA 0300101)	0	13.4±0.3	46.1±0.9*	11.7±0.9*
<i>T. durum</i> Desf. (Perlyna)	77	12.9±0.4	48.9±0.5*	7.5±1.1
<i>T. dicoccum</i> (UA 0300164) var. <i>dicoccum</i>	70	14.7±0.3*	52.3±0.7*	13.2±1.0*
<i>T. dicoccum</i> (UA 0300087) var. <i>rufum</i>	81	16.7±0.2*	60.4±0.8*	13.8±0.8*

Comments: * – differences significant at $p \geq 0.95$: compared to *T. aestivum* (Selyanka) for *T. spelta* landraces; compared to *T. durum* (Perlyna) for *T. dicoccum* landraces; ¹⁾ proteins soluble in 1-isopropanol fraction, % from total protein content.

Примітки: * – відмінності достовірні за $p \geq 0.95$: порівняно із *T. aestivum* (для зразків *T. spelta*); порівняно із *T. durum* (для зразків *T. dicoccum*); ¹⁾ фракція білків, розчинних у 1-ізопропанолі, % від загального вмісту білка.

Protein content is one of the most important characteristics of the grain which corresponds to its nutritional value. Our data showed that both of studied emmer landraces and one of the studied spelt landraces (UA 0300259) had higher protein content than commercial wheat cultivars grain. The highest values were obtained for spelt UA 0300259 landrace. It was for 5.3 % higher than modern wheat cultivars. The high protein content of emmer and spelt is in good agreement with other data where spelt was always superior to wheat [20]. Several investigations suggested a superior grain protein content in *T. spelta* L. and *T. dicoccum* Schrank Schuebl if compare with genetically homological hullless species (*T. durum* Desf. and *T. aestivum* L.) [1, 18, 20].

It should to be mentioned that nutritional value of the grain is determined not only by the total amount of protein, but in the large extent by its quality. The bread-making quality of flour depends on both protein content and protein type, especially on the gluten composition [7].

For the determining of protein quality we measured the total dry gluten content and the content of proteins soluble in 1-isopropanol. Dry gluten content in all studied emmer and spelt landraces was higher than in wheat cultivars without statistically significant differences between landraces. Separation of proteins in 50 % (v/v) 1-propanol was shown to be a good method for fractionation of monomeric (albumins, globulins and

gladins) and complex (native unreduced) glutenin proteins. The proteins soluble in 1-propanol (50 PS) were a mixture of monomeric proteins and polymeric glutenin, whereas insoluble in 1-propanol proteins (50 PI) were essentially free of monomeric proteins and comprised mainly of glutenin [8].

Content of soluble in 1-propanol protein fraction (monomeric proteins) measured for spelt and emmer landraces grain was higher than for modern winter wheat. The highest level was estimated for emmer landrace UA 0300087, the lowest one for spelt landrace UA0300101. So spelt and emmer grain were richer by monomeric proteins in comparison with bread wheat and durum wheat grain. Better grain quality indicators among emmer landraces were obtained for the UA 0300087 landrace (*T. dicoccum* var. *rufum*), and for the UA 0300259 among spelt landraces (*T. spelta* var. *atratum*).

Post-harvested seeds were germinated in laboratory conditions and tested for germinability, seedling biomorphology and chlorophyll content (*a* + *b*) in leaves (Table 3).

Table 3. Seed germination, seedlings biomorphology and chlorophyll content in leaves of hulled wheat species (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) and commercial wheat species (*T. aestivum* L., *T. durum* Desf.) studied in laboratory conditions

Таблиця 3. Схожість, біометричні параметри та вміст хлорофілу в проростках видів півчастих пшениць (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) і комерційних видів пшениці (*T. aestivum* L., *T. durum* Desf.) за лабораторних умов

Cultivar, landrace	Germination potential, %	Shoot length, cm	Root (total), cm	Shoot weight, g	Root weight, g	Total chlorophyll content (<i>a</i> + <i>b</i>) mg/g FW
<i>T. aestivum</i> L. (Selyanka)	96±4	9.10±0.43	33.20±1.67	0.26±0.04	0.15±0.04	1.00±0.03
<i>T. spelta</i> L. (UA 0300259)	96±4	12.10±0.52*	45.20±1.55*	0.37±0.03*	0.28±0.03*	1.24±0.07*
<i>T. spelta</i> L. (UA 0300101)	96±2	11.80±0.43*	33.20±1.87	0.33±0.08	0.31±0.07*	1.13±0.03*
<i>T. durum</i> Desf. (Perlyna)	98±2	10.00±0.47	30.50±1.87	0.28±0.04	0.18±0.05	1.02±0.05
<i>T. dicoccum</i> (UA 0300164) var. <i>dicoccum</i>	96±4	10.10±0.54	30.60±1.98	0.34±0.06	0.16±0.03	0.85±0.05*
<i>T. dicoccum</i> (UA 0300087) var. <i>rufum</i>	98±2	12.40±0.56*	45.00±1.75*	0.41±0.03**	0.13±0.03	1.25±0.07*

Comments: * – differences significant at $p \geq 0.95$: compared to *T. aestivum* (Selyanka) for *T. spelta* landraces; compared to *T. durum* (Perlyna) for *T. dicoccum* landraces.

Примітки: * – відмінності достовірні за $p \geq 0,95$: порівняно із *T. aestivum* (для зразків *T. spelta*); порівняно із *T. durum* (для зразків *T. dicoccum*).

According to our results, all samples had high germinability without statistically significant differences among studied species, cultivars and landraces. Studied hulled wheat landraces were characterized by higher seedlings' length in comparison to Selyanka cultivar: 30–32 % higher for spelt landraces and 9–36 % higher for emmer landraces. That

corresponds to the literature data [3], where more intensive initial seedlings growth was reported for hulled wheat species. It can play an adaptive role in a flooding resistance. Between hulled wheat landraces highest indicators of seedling biomorphology were obtained for spelt UA0300259 landrace and emmer UA 0300087 landrace. This landraces were also characterized by higher root length and shoot weight.

The chlorophyll content is an important indicator of plant functioning and is important for plant productivity formation and work of plant photosynthetic apparatus. Determining of chlorophyll content in seedlings showed that spelt landraces and emmer UA 0300087 landrace had higher (13–25 % depend on landrace) total chlorophyll content in comparison with modern wheat cultivars.

So, higher seedlings biomorphological parameters among emmer landraces were obtained for the UA 0300087 emmer landrace (*T. dicoccum* var. *rufum*), and for the UA 0300259 among spelt landraces (*T. spelta* var. *atratum*).

During storage, seeds suffer from various stress factors which lead to aging, forming further a weak seedlings and plants or even losing their germinability. The main damaging factors during seed storage are high humidity and temperature, which lead to peroxide membrane damaging activation [9, 24]. Accelerated aging test [25] was shown to be a good indicator of common non-specific stress resistance of seeds. It is also used as predictive test for seeds storage potential.

The results of accelerated aging test are presented in Table 4.

Table 4. Seed germination potential of hulled wheat species (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) and commercial wheat species (*T. aestivum* L., *T. durum* Desf.), and morphometrical parameters of seedlings after accelerated aging (+37 °C, 100 % humidity during 7 days), % to germination and morphometrical parameters under control conditions (germination at 24 °C on distilled water)

Таблиця 4. Схожість насіння та морфометричні показники проростків видів півчастих пшениць (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) та комерційних видів пшениці (*T. aestivum* L., *T. durum* Desf.) після прискореного старіння (+37 °C, 100% вологість протягом 7 діб), % від схожості ρ морфометричних параметрів за контрольних умов пророщування (24 °C на дистильованій воді)

Cultivar, landrace	Germination potential	Shoot length	Root length	Shoot weight	Root weight
<i>T. aestivum</i> L. (Selyanka)	77±3	58±4	29±2	35±2	73±3
<i>T. spelta</i> L. (UA 0300259)	60±4*	51±2	39±2*	22±2*	68±2
<i>T. spelta</i> L. (UA 0300101)	54±4*	42±2*	24±2*	15±2*	50±4*
<i>T. durum</i> Desf. (Perlyna)	71±2	43±2	28±4	30±4	71±2
<i>T. dicoccum</i> (UA 0300164) var. <i>dicoccum</i>	45±4**	42±2	22±2	28±2	60±3*
<i>T. dicoccum</i> (UA 0300087) var. <i>rufum</i>	54±2**	47±4	36±4	38±4	77±4

Comments: * – differences significant at $p \geq 0.95$: compared to *T. aestivum* (Selyanka) for *T. spelta* landraces; compared to *T. durum* (Perlyna) for *T. dicoccum* landraces.

Примітки: * – відмінності достовірні за $p \geq 0,95$: порівняно із *T. aestivum* (для зразків *T. spelta*); порівняно із *T. durum* (для зразків *T. dicoccum*).

According to our results, Selyanka cultivar winter wheat seeds were the most tolerant according to accelerated aging test. Hulled wheat species had lower viability parameters under accelerated aging influence in comparison with commercial wheat cultivars.

Among spelt landraces UA 0300101 seeds were most tolerant to unfavorable conditions; among emmer landraces better results were obtained for UA 0300087 landrace.

CONCLUSIONS

Studied hulled wheat landraces harvested in Ukraine South Steppe had different characteristics of plant productivity, grain quality, germinability and viability characteristics of grain.

Under the standard germination conditions, seeds from both hulled wheat species were characterized by more intensive seedlings growth in comparison with modern wheat cultivars. At the same time, hulled wheat seeds had lower germination potential and biomorphological parameters of seedlings according to accelerated aging test if compare with wheat cultivars.

Seeds productivity for both spelt and one emmer landrace was 35–54 % lower than for commercial wheat cultivars and emmer UA 0300087 landrace had productivity similar to durum wheat Perlyna cultivar. Hulled wheat species had various grain hardness parameters and were characterized by a higher (for 0.5–5.3 %) grain protein content and its different composition in comparison with modern wheat cultivars.

Among emmer landraces, UA 0300087 (*T. dicoccum* var. *rufum*) was characterized by higher seed productivity under Ukraine South Steppe conditions, higher 1000 grain weight, it formed grain with better quality, higher viability (determined by accelerated aging test). This landrace's seeds formed seedlings with better biomorphological parameters and higher chlorophyll content.

Both studied spelt landraces didn't show statistically significant differences on productivity and 1000 grain weight parameters, but UA 0300259 landrace (*T. spelta* var. *atratum*) formed grain with better technological characteristics, more tolerant to accelerated aging test and able to form seedlings with better biomorphological characteristics.

So, seeds with superior characteristics of 1000 grain weight and formed by plants with higher productivity under Ukrainian South Steppe zone conditions were also characterized by a higher grain quality and viability.

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ХАРАКТЕРИСТИКА ПРОРОСТАННЯ, ЖИТТЄЗДАТНОСТІ ТА ЯКОСТІ НАСІННЯ ПЛІВЧАСТИХ ПШЕНИЦЬ (*TRITICUM SPELTA* L., *TRITICUM DICOCCUM* SCHRANK SCHUEBL.)

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У роботі були досліджені показники зернової продуктивності, життєздатності та якості насіння двох видів плівчатої пшениці (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) озимої форми розвитку, вирощених на півдні степової зони України, а також проведено порівняння їх із аналогічними показниками сортів озимої м'якої і твердої пшениці (*T. aestivum* L., *T. durum* Desf.). Встановлено, що значення насінневої продуктивності колосу у двох зразків *T. spelta* L. і зразка *T. dicoccum* Schrank Schuebl. достовірно не відрізнялися між собою та були нижчими на 35–54 %,

ніж у дослідних сортів. Насіння *T. spelta* L. та *T. dicoccum* Schrank Schuebl, порівняно зі сортами пшениці, характеризувалося більшим вмістом сухої клейковини, вмістом білка та його розчинних фракцій. За результатами стандартного випробування лабораторної схожості насіння, дослідні зразки всіх видів достовірно не відрізнялись, а окремі зразки плівчастих пшениць відрізнялися між собою за біометричними показниками проростків і за вмістом хлорофілу в листках. Водночас, обидва види плівчастої пшениці виявили нижчу, порівняно зі сортами, життєздатність насіння за тестом прискореного старіння. З'ясовано, що зразки плівчастих пшениць, які характеризувалися більшою насінневою продуктивністю, також мали насіння із більшим вмістом білка, формували проростки кращої якості й відрізнялися більшою стійкістю до впливу несприятливих чинників.

Ключові слова: *Triticum dicoccum* Schrank Schuebl., *Triticum spelta* L., якість насіння, проростки, прискорене старіння, вміст хлорофілу.

ХАРАКТЕРИСТИКА ПРОРАСТАННЯ, ЖИЗНЕСПОСОБНОСТІ И КАЧЕСТВА СЕМЯН ПЛЕНЧАТЫХ ПШЕНИЦ (*TRITICUM SPELTA* L., *TRITICUM DICOCCUM* SCHRANK SCHUEBL.)

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В работе были исследованы показатели зерновой продуктивности, жизнеспособности и качества семян двух видов пленчатой пшеницы (*Triticum spelta* L., *Triticum dicoccum* Schrank Schuebl.) озимой формы развития, выращенных на юге степной зоны Украины, а также проведено их сравнение с аналогичными показателями сортов озимой мягкой и твердой пшеницы (*T. aestivum* L., *T. durum* Desf.). Установлено, что значения семенной продуктивности колоса у двух образцов *T. spelta* L. и образца *T. dicoccum* Schrank Schuebl. достоверно не отличались между собой и были на 35–54 % ниже, чем у исследуемых сортов. Семена *T. spelta* L. и *T. dicoccum* Schrank Schuebl., в сравнении с сортами пшеницы, характеризовались большим содержанием сухой клейковины, содержанием общего белка и его растворимых фракций. По результатам стандартного определения лабораторной всхожести семян, исследуемые образцы всех видов достоверно не отличались, а отдельные образцы пленчатых пшениц отличались между собой биометрическими показателям проростков и содержанием хлорофилла в листьях. В то же время, оба вида пленчатой пшеницы имели более низкую, по сравнению с сортами, жизнеспособность семян в условиях теста ускоренного старения. Показано, что образцы пленчатых пшениц, которые формировали большую семенную продуктивность, также имели семена, характеризующиеся большим содержанием белка, формировали проростки лучшего качества и отличались большей стойкостью к неблагоприятным факторам.

Ключевые слова: *Triticum dicoccum* Schrank Schuebl., *Triticum spelta* L., качество семян, проростки, ускоренное старение, содержание хлорофилла.

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