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Evaluation of Protein and Some Morphological Indicators in Wheat Samples of Different Ploidy

Abstract

Wheat is second only to corn, with an annual production of 650 million tons it is the most cultivated cereal plant. 25 % of the world's agricultural land is wheat used for plant cultivation. From ancient times to the present day, wheat has been the daily food requirement of the population as the main food crop, occupying one of the most important places in payment. The basis of human nutrition is bread made from soft wheat (*Triticum aestivum* L.) flour and bakery products made from durum wheat (*T. durum* Desf.). It consists of various cereals, pasta, and other food products. Productivity increases by creating productive varieties with high quantitative and qualitative indicators it is possible. Acceleration of selection processes and initial material for creation, the quality indicators of the grains are high. This protein is genetic during the selection of foundation forms the use of markers is appropriate. All agronomic, yield, yield-related, and quality traits on plant and plot basis were recorded from the two middle rows units. Plant-based data were collected from randomly selected and representative 10 plants in the plot while, the plot-based data were collected from the whole harvestable plot. Agronomical traits include plant height, spike length, number of spikelets per spike, number of seeds per spike, seed weight per spike, thousand kernel weight, plant density, and grain protein content. This research was conducted in the grain and leguminous field laboratory of the Azerbaijan State Agrarian University between 2022 and 2023. Phenological observations from the outlet. It was carried out according to Kuperman from the beginning to the full ripening phase. The article on the genetics of some wheat samples with different ploidy studies of diversity based on phenology signs and gliadin proteins and the results obtained are dedicated to comparison.

Keywords: *grain quality, gluten, protein content, morphological index, wheat plant*

Introduction

Wheat (Triticum aestivum L.) is one of the world’s most important food crops and a primary food source for an estimated 35 % of the world’s population (Grote et al., 2021). Wheat alone supplies a fifth of global food calories and protein (Spanicet al., 2024). Although global wheat production is currently over 700 million tons (Yue, Zhang, & Shang, 2022), the demand for wheat production is projected to increase by 60 % by 2050. Moreover, wheat production is expected to decline due to decreases in land suitability in low latitude areas and to climate changes (high temperatures, heat waves, and droughts) (WorldFoodSituation, 2019), while the world population will increase. Furthermore, it is not negligible that new pests and diseases and new races of existing diseases have emerged (Sunic et al., 2023). Therefore, there is a timely, dire need to evolve new

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wheat varieties with traits that could tolerate different stresses and produce higher grain yields. Traits such as crop architecture, phenological date, and spike- and grain-related morphological characteristics are involved in grain yield formation (Li et al., 2023). Due to variations in climate-, biotic-, and abiotic stresses, there are demands for the adaptation of wheat varieties with different phenotypic traits.

Research

The interaction of complex networks of genes with each other and the environment underlies wheat adaptation and influences many phenotypic traits of wheat (Wu, Chang, & Jing, 2021). According to Hyles et al. (2020), wheat adaptation could be achieved through variation in phenology (seasonal timing of the lifecycle) and related traits (e.g., those affecting plant architecture). Nevertheless, the phenological expression of wheat plants is impacted by the environment and genetics, thus allowing wheat genotypes to achieve optimum productivity in the environment in which they were primarily created (Yu & Chung, 2021). In the same research, it was also reported that environmental effects (E) explained approximately 72.2 % of the total variation, whereas genotype (G) and GE interactions explained 6.9 and 18.3 %, respectively. The assessment of genetic diversity is carried out via different marker techniques, such as morphological, biochemical, and molecular markers (Govindaraj et a., 2015). The morphological characteristics of wheat differ according to the genetic composition of the variety (Min et al., 2020). Moreover, the evaluations of phenotypic diversity or morphological traits are important in the differentiation of wheat varieties (Franco et al., 2001). Genetic diversity is fundamental for conducting successful crop improvement programs. The objectives of this study were to assess the genetic diversity and to deduce the population structure among bread wheat (Triticum aestivum L.) genotypes using phenotypic traits (Yu & Chung, 2021). Before their release into production, and are granted plant variety protection, the most common system of intellectual property protection. The storage proteins of gliadin and gluten, called gluten proteins make up 80 % of the endosperm of the wheat grain, so baking flour knows its quality. Soft wheat the quality indicators of the bread made from flour of different varieties, mainly depends on the ratio of gliadin and gluten storage proteins since these proteins are quality indicators as genetic markers the study of which is scientifically and practically very relevant. The characteristics of a quality variety of bread are determined. Organic and non-organic bread are necessary for human-related topics. High-resolution baked goods from the world level with formation, including hybridization and others by the application of the methods, and also some to the wheat flour produced by improving the quality of additions extensive scientific research works.

Materials and Methods

The study was conducted on 50 samples of wheat of different ploidy in the field laboratory of "Grains and Legumes" field laboratory of Azerbaijan State Agrarian University. Sowing (468m altitude, 40°40´N, 46°20´E) was planted. 2 of the samples are diploid (including -2 T.monococcum), 37 are tetraploid (including-26-T.durum, 4-T.timopheevi, 2-T.polonicum, 3-T.turgidum, 2-T. dicoccum), 11 were additional hexaploid (including 5-T. spelta, 6-T.aestivum) wheat samples. Phenological observations were made according to Kuperman. At the same time, analyzes of grains in the grain quality laboratory at the Agricultural Scientific-Research Institute - the mass of 1000 grains, vitreousness taking into account the amount of vitreous and semi-vitreous grains in the cross-section of the grain, the amount of gluten by washing the starch and bran from the dough by hand washing in running water, and the deformation coefficient of gluten (GDE) Made in Russia The quality group of gluten was determined with the help of IDK-1 device. Determination of total nitrogen (Modified Keldal micromethod) was determined.

Results and their Discussion

Height productivity is one of the important morphological traits that plays the main role in wheat plants. In the conditions of Azerbaijan, the optimal height of a wheat plant can be considered 70-146 cm. Biomorphological indicators of local and introduced durum wheat genotypes were comparatively studied (Table 1). The tallest sample of T. durum var. hordeiforme Körn.was 70 cm, and T.durum, T.durum var.leucurum Körn was 133 cm. The number of productive stems was

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between 6-13. The morphological characteristics of flag leaves are one of the most important determinants of plant architecture and yield potential. From the morphological indicators of the spike, the length of the spike was 4,5-11 cm. T.turgidum was 4,5 cm. T.spelta and T.durum were 11 cm. The mass of 1000 grains in the samples varied between 30.3-56.3 g. GWS was between 0.6-2.5. The highest indicator was T.durum 2.6 g in durum wheat and the lowest was T.durum 0.6 g. The number of productive stems was between 6-13. The highest indicator was 13 stems in T.spelta, and the others were between 7-8. The number of spikelets in the spike was determined to be the highest in T.monococcum, 28, and the lowest in T.dicoccum, 13.

Table 1

Biomor phological characteristics of wheat genotypes of different origins

№	**Species**	**PH, cm**	**SPL, cm**	**MS, cm**	**SNS, number**	**GWS, g**	**TGW, G**
1	**2**	**4**	**5**	**6**	**7**	**8**	**9**
1	T.durum *var.* valenciae *Körn.*	88	7,0	8	15	1,2	36,2
2	T.durum *var.leucurum Körn.*	135	6,8	8	17	1,5	44,1
3	T.durum *var.affine Körn.*	135	7,5	7	16	2	34,5
4	T.polonicum	82	8,0	10	18	2,3	33,9
5	T.durum var. valenciae *Körn.*	85	7,0	9	19	0,9	42,7
6	T.polonicum	69	10	9	19	1,6	39,3
7	T.spelta	80	7,5	12	14	1,3	41,7
8	T.turgidum	79	9,5	7	15	1,5	39,8
9	T.durum var.melanopus Körn.	114	7,2	7	21	2,6	50,3
10	T.aestivum	96	8,0	12	17	1,7	45
11	T.durum var.obscurum Körn.	90	7,9	10	23	1,6	42,9
12	T.durum var.hordeiformeKörn.	70	7,4	9,5	21	1,9	52,3
13	T.durum var.leucomelan Körn.	99	6,8	10	21	2,6	36,8
14	T.turgidum	87	9,0	9	16	0,9	50,6
15	T.durum var.provinciale Körn.	74	5,8	11	23	1,8	47,6
16	T.durum var.valenciae Körn.	146	7,0	10	22	2,5	51,2
17	T.durum var.leucurum Körn.	133	7,6	9	19	1,5	39,6
18	T.turgidum	118	4,5	9	15	2,3	38,5
19	T.durum var.fastuosum Körn.	145	9,3	10	23	2,5	47,6
20	T.durum var.reichenbachiiKörn.	86	8,0	8	18	2	44,3
21	T.timopheevi	83	9,0	6	22	1,9	35,6
22	T.spelta	72	11	13	15	2,5	38,9
23	T.aestivum	89	7,5	11	19	2,2	51,3
24	T.turgidium	140	9,0	8	17	1,8	34,9
25	T.durum	78	7,5	9	21	1,4	42,6
26	T.timopheevi	93	10	8	26	2,2	45,9
27	T.durum	137	9,0	9	26	2,6	48,6
28	T. spelta	84	7,0	11	12	1,8	52,3
29	T. spelta	74	8,5	13	14	1,2	39,4
30	T.durum	115	10	9	21	0,6	56,3
31	T.aestivum	78	6,9	8	18	1,5	49,8
32	T.aestivum	99	8,0	8	17	2,4	51,3
33	T.aestivum	76	10	6	14	1,6	38,4
34	T.monococcum	90.6	7,9	7,4	20,5	0,96	30,3

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35	T.durum	73	6,4	7	16	1,2	49
36	T.durum	74	7,5	9	18	1,5	51,3
37	T.aestivum	126	7,5	11	14	2,3	50,6
38	T.durum	133	9,8	9	22	1,6	46,8
39	T.durum	84	11	7	21	1,4	49,6
40	T.timopheevi	68	7,5	8	25	1,3	53,6
41	T.durum	89	6,0	9	22	3	44,6
42	T.durum	136	6,0	6	20	1,7	49,8
43	T.durum	70	7,8	8	23	0,9	45,9
44	T.monococcum	98	8,0	7	28	1,6	55
45	T. spelta	99	6,0	13	19	1,8	39
46	T.timopheevi	86	10	7	24	1,5	45,8
47	T.dicoccum	80	7,3	7	16	1,5	44,3
48	T.durum	83	9,5	8	20	1,6	43,7
49	T.durum	94	8,2	7	18	0,7	51,3
50	T.dicoccum	78	8,0	6	13	1,2	39,4

Keys to abbreviations: PH: plant height, **SPL:** spike length, **SPS:** the number of grains spike, **TGW:** thousand-grain weight, **GWS** grain weight of per spike, **SNS**: spikelet number per spike, **MS:** on the main stems.

The biochemical indicators of the grain, the amount of gluten and the amount of total protein in wheat samples of different origins, were studied on 15 samples. From the physical parameters of the grain, the vitreousness varied between 24-100 % in the studied samples (Table 2). In the T. durum var. leucurum (Alef.) Körn. sample, it was determined that the vitreousness was 100 %. However, in the T. spelta var. menabdii Dorof. and T. monococcum var. flavescens Körn. samples, the vitreousness was 24.0 % and 31.0 %. In the research work, the GDE (deformation coefficient of gluten) varied between 63.7 and 97.5 units (instrument indicator). The highest indicator was T. durum var. valenciae Körn. (97.5). The protein was between 12.0 and 15.4. The highest indicator was T. durum var. valenciae Körn. and T. durum var. leucurum (Alef.) Korn. samples. Gluten was between 22.2 and 37.2.

Table 2
Quality indicators of polyploid wheat genotypes

№	**Species**	**Vitreiuoss %**	**Gluten %**	**GDƏ c.g**	**Protein %**
1	T. aestivum *var.* nigrum *Körn.*	57,0	22,2	65,9	12,0
2	T. aestivum *var.* ferrugineum *(Alef.) Mansf.*	76,5	30,0	80,7	13,8
3	T. durum *var.* valenciae *Körn.*	81,5	31,0	97,5	14,6
4	T. turgidumvar. fumidum Körn.	60,5	31,8	65,5	13,4
5	T. spelta var. menabdii Dorof.	24,0	22,4	86,3	12,6
6	T. aestivum *var.* lutescens *(Alef.) Mansf.*	65,5	26,8	89,9	12,6
7	T. timopheevii var. typicum Zhuk.	60,0	35,2	82,7	12,0
8	T. durum *var.* leucurum *(Alef.) Körn.*	100	34,8	88,4	14,6
9	T. monococcum var. flavescens Körn.	31,0	37,2	80,3	12,6
10	T. dicoccum rufum automnal *Stolet.*	73,0	36,0	63,7	16,2
11	T. vulgare *var.* milturum *Alef.*	73,5	26,0	94,4	13,8
12	T. aestivum *var.*erythroleucon *(Körn.) Mansf.*	65,5	30,0	96,1	15,4
13	T. durum *var.* affine *Körn.*	100	28,6	84,4	14,6
14	T. durum *var.* erythromelan *Körn*	77,0	32,0	89,4	14,4
15	T. durum *var.* libycum *Körn*	100	30,5	82,6	15,0

Conclusion

Thus we when look at the morphological characteristics of the genotypes, the shortest plant was height in T. durum. When we pay attention to the productivity elements, T. spelta was selected for its spike length, the mass of grain in 1 spike and the weight of 1000 grains were high in the samples of durum wheat species, but physiological indicators prevailed in the genotypes of wild species and they might be used as starting material in selection. According to the qualitative indicators, the glassiness of the grain was studied in the samples of T. durum var. libycum Körn and T. durum var. affine Körn. dominated. Research work is ongoing.

References

1. Franco, J., Crossa, J., Ribaut, J. M., Betran, J., Warburton, M., & Khairallah, M. (2001). A method for combining molecular markers and phenotypic attributes for classifying plant genotypes. *Theoretical and Applied Genetics,* 103(6), 944–952. https://doi.org/10.1007/s001220100616
2. Govindaraj, M., Vetriventhan, M., & Srinivasan, M. (2015). Importance of genetic diversity assessment in crop plants and its recent advances: An overview of its analytical perspectives. *Genetics Research International,* 431487. https://doi.org/10.1155/2015/431487
3. Grote, U., Fasse, A., Nguyen, T. T., & Erenstein, O. (2021). Food security and the dynamics of wheat and maize value chains in Africa and Asia. *Frontiers in Sustainable Food Systems,* 4, 617009. https://doi.org/10.3389/fsufs.2020.617009
4. Hyles, J., Bloomfield, M. T., Hunt, J. R., Trethowan, R. M., & Trevaskis, B. (2020). Phenology and related traits for wheat adaptation. *Heredity,* 125(4), 417–430. https://doi.org/10.1038/s41437-020-0290-7
5. Hussein, S., Mark, L., & Isack, M. (2020). *Genetic diversity and population structure of bread wheat genotypes determined via phenotypic and SSR marker analyses under drought-stress conditions.* https://doi.org/10.1007/s001220100616
6. Li, Y., Tao, F., Hao, Y., Tong, J., Xiao, Y., He, Z., & Reynolds, M. (2023). Variations in phenological, physiological, plant architectural, and yield-related traits, their associations with grain yield and genetic basis. *Annals of Botany,* 131, 503–519. https://doi.org/10.1093/aob/mcad014
7. Min, B., Salt, L., Wilde, P., Kosik, O., Hassall, K., Przewieslik-Allen, A., Burridge, A. J., Poole, M., Snape, J., Wingen, L., et al. (2020). Genetic variation in wheat grain quality is associated with differences in the galactolipid content of flour and the gas bubble properties of dough liquor. *Food Chemistry,* 6, 100093. https://doi.org/10.1016/j.foodchem.2020.100093
8. Shajitha, P., Nisha, R., Sivasamy, M., et al. (2024). Integrating solid stem and multiple disease resistance for developing climate-resilient wheat (Triticum aestivum L.). *Cereal Research Communications*. https://doi.org/10.1007/s42976-024-00614-3
9. Sunic, K., Brkljacic, L., Vukovic, R., Katanic, Z., Salopek-Sondi, B., & Spanic, V. (2023). Fusarium head blight infection-induced responses of six winter wheat varieties in ascorbate–glutathione pathway, photosynthetic efficiency, and stress hormones. *Plants,* 12, 3720. https://doi.org/10.3390/plants12213720
10. Spanic, V., Jukic, G., Zoric, M., & Varnica, I. (2024). Some agronomic properties of winter wheat genotypes grown at different locations in Croatia. *Agriculture,* 14. https://doi.org/10.3390/agriculture14010000
11. Wu, X., Chang, X., & Jing, R. (2012). Genetic insight into yield-associated traits of wheat grown in multiple rain-fed environments. *PLoS ONE,* 7(11), e31249. https://doi.org/10.1371/journal.pone.0031249
12. Yue, Y., Zhang, P., & Shang, Y. (2022). The potential global distribution and dynamics of wheat under multiple climate change scenarios. *Sci. Total Environ.,* 688, 1308–1318. https://doi.org/10.1016/j.scitotenv.2019.06.334

ISSN: 2707-1146
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13. Yu, J. K., & Chung, Y. S. (2021). Plant variety protection: Current practices and insights. *Genes*, 12(7), 1127. https://doi.org/10.3390/genes12071127

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