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STUDY OF THE POSSIBILITIES OF GROWING WINTER COMMON WHEAT (*TRITICUM AESTIVUM* L.) IN A BIOLOGICAL WAY IN THE VARNA REGION

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Abstract

In 2021-2023, at the educational and experimental field of the Department of Plant Production at the Technical University - Varna, a study was conducted with two varieties of winter common wheat, a selection of the Dobrudzha Agricultural Institute - General Toshevo: Merilyn and Nikodim. They were grown according to the methods of biological production - no fertilization was carried out on the experimental plot since 2018, and during the growing season they were not treated with plant protection preparations. The trial was carried out by the split plot method with the size of the experimental area of 10 m^2 in two replicates with a seeding rate of 600 germinating seeds/m^2. The following indicators have been established: grain yield (t/ha) - Yields, length of main spike (cm) - LMS, weight of grains per spike (g) - WGS, mass of 1000 grains (g) - M 1000, hectoliter mass (kg) – Test Weight, protein content (%) – Protein, starch content (%) – Starch and ash substances content (%) – Ash. It was established that the combination of meteorological factors (amount of precipitation and dynamics of average daytime temperatures) in the second year of the study (2021-2022) exerted the most favorable influence on the formation of maximum productivity and quality of wheat. The Merilyn variety is superior in terms of productivity and quality to the Nikodim variety under the conditions of organic cultivation in the Varna region, on average over the three experimental years. The differences between the two investigated varieties are greater in quality indicators (protein and starch content) than in the values of grain yield and its structural elements.

Key words: ***year, variety, wheat, yields, protein***

INTRODUCTION

Wheat is a major cereal crop and the nutrition of mankind is connected with it. The growth of the earth's population and economic growth increases the demand for wheat. This leads to an increased demand for food sources, having available natural resources. New, innovative methods are sought to increase the productivity and efficiency of agriculture; ways to optimize the use of basic resources in order to meet the ever-increasing demand for agricultural products. In addition, agriculture, in order to continue feeding the world, must reduce its harmful impact on the climate and the environment. (Arora, 2019; Geng et al., 2019; Shahzad et al., 2021; Habib-ur-Rahman, 2022; Wang, 2022).

Increasing the productivity and improving the quality of wheat grain are becoming increasingly important. The formed yield of grain is a total quantity that is determined by the interaction of the genotype with the conditions of the environment and the level of applied agricultural technology. It is a complex indicator that is largely influenced by changing environmental factors: increase in average annual temperatures; prolonged droughts alternating in places with heavy rains and storms; tendency for two-season climate and others. There are numerous studies in which grain yield and the many factors that affect it are the subject of study. (Fisher et al., 2019; Hu et al., 2019; Cossani & Sadras, 2021; Hu et al., 2021; Slafer et al., 2022).

Improving the quality of wheat grain is a problem that is relevant worldwide and related to complete nutrition. Wheat is a major source of vegetable protein in the human diet because it is characterized by a higher protein content than corn, rice and other cereal crops. The quality of wheat depends on the genotype and the ability of the grain to accumulate protein. The main indicators that characterize the grain quality are the mass of 1000 grains (the absolute mass), the hectoliter mass and the protein content. The mass of 1000 grains is related to the technological value and quality of the grain as seed material, as well as its ability to germinate and grow. Hectoliter mass is a measure of the bulk density of the grain. Test weight is a fast-ascertainable indicator of grain quality. The protein content determines the nutritional value of the grain and its technological properties. (Blandino et al., 2020; Jaenisch et al., 2020; Pan et al., 2020; Bloom & Plant, 2021; Liu et al., 2021; Giordano et al., 2023; Zhang et al., 2023).

The purpose of the study is to determine the productivity and some quality indicators of two varieties of winter common wheat, a selection of the Dobrudzha Agricultural Institute - General Toshevo, grown without fertilization in the conditions of organic production in the Varna region.

MATERIALS AND METHODS

The research was conducted during the period 2021-2023 at the educational and experimental field of the Department of Plant Production at the Technical University - Varna. The soil type of the experimental plot is Carbonate Chernozems (Calcic Chernozems, FAO (2002). The agrochemical analyzes of the soil were carried out in the Soil Science Laboratory of the Technical University - Varna using the following methods:

The content of ammonium nitrogen (NH_4-N) was determined photometrically with indophenol blue as a result of extraction with a solution of calcium dichloride ($CaCl_2$). Nitrate nitrogen (NO_3-N) was determined photometrically with Nitrospectral as a result of extraction with a solution of calcium dichloride ($CaCl_2$). The content of phosphorus and potassium was determined by the Egner-Riim double-lactate method (Tomov et al.,1999; Ruseva, 2011).

The values of the soil reaction were measured potentiometrically with a pH meter, according to the requirements of the methodology for measuring soil pH according to the international standard ISO 10390.

From the analyzes carried out before starting the experiment, a good supply of absorbable potassium is reported. Potassium content in the 0-30 cm soil layer of 30.18 mg/100 g soil was reported. Good stocking in terms of mobile phosphates 29.56 mg/100 g soil was also found. The total nitrogen content is low. The soil reaction is neutral (Table 1).

Table 1. Agrochemical parameters of the soil.

Depth, cm	pH H_2O	NH_4 N, mg/kg	NO_3 N, mg/kg	Total Mineral N, mg/kg	P_2O_5, mg/100g	K_2O, mg/100g
0-30	6,5	3,27	18,21	21,48	29,56	30,18

The experiment was carried out using the split plot method with the size of the experimental area of 10 m^2 in two replications with a seeding rate of 600 germinating seeds/m^2. Tillage includes milling the experimental plot, forming the experimental plots and paths. During the years of the study, sowing was carried out at the end of October and harvesting - at the beginning of July. The objects of the study are two varieties of winter common wheat, a selection of the Dobrudzha Agricultural Institute - General Toshevo: Merilyn and Nikodim. They were grown according to the methods of biological production - no fertilization was carried out on the experimental plot since 2018, and during the growing season they were not treated with plant protection preparations.

The following indicators have been established:

- grain yield (t/ha) – Yields

- length of main spike (cm) – LMS
- weight of grains per spike (g) – WGS
- mass of 1000 grains (g) - M 1000
- hectoliter mass (kg) – Test Weight
- protein content (%) – Protein
- starch content (%) – Starch
- ash substances content (%) – Ash

The statistical processing of the data was done using the statistical package SPSS 26 and Microsoft Excel.

RESULTS AND DISCUSSIONS

The years during which the study was conducted differ in the amount and distribution of rain during the wheat vegetation and the dynamics of temperatures (Figure 1). Closer in terms of meteorological data are the first (2020-2021) and second (2021-2022) years. At the beginning of the autumn-winter wheat vegetation (October, November, December), the soil moisture reserve is greater in the second year (2021-2022). The average day and night temperatures measured in October, when the sowing was carried out, have similar values, but November of 2021-2022 is 3.5^0C warmer, and in December, which is a typical winter month, negative values of -3.8^0C were measured. This combination of weather elements resulted in better rooting and development of the wheat crop early in the second year's growing season. In the months of January, February and March, the amount of precipitation is much higher than in the first year of the study (2020-2021), but its distribution is uneven. During the spring critical period (April-May), when the plants are in the booting-head emergence/flowering phase (Zadoks et al., 1974), the amounts of precipitation are again higher in 2021-2022 and April is 3.2^0C warmer than the previous year. These conditions are favorable for the development of wheat during the spring vegetation of the second year. The third year of the study (2022-2023) is meteorologically specific. The average sum of the amount of precipitation that fell throughout the growing season, as well as of the autumn-winter moisture reserve (October-March) is 50% lower than the previous two years. In terms of temperature, it also stands out as a warmer year.

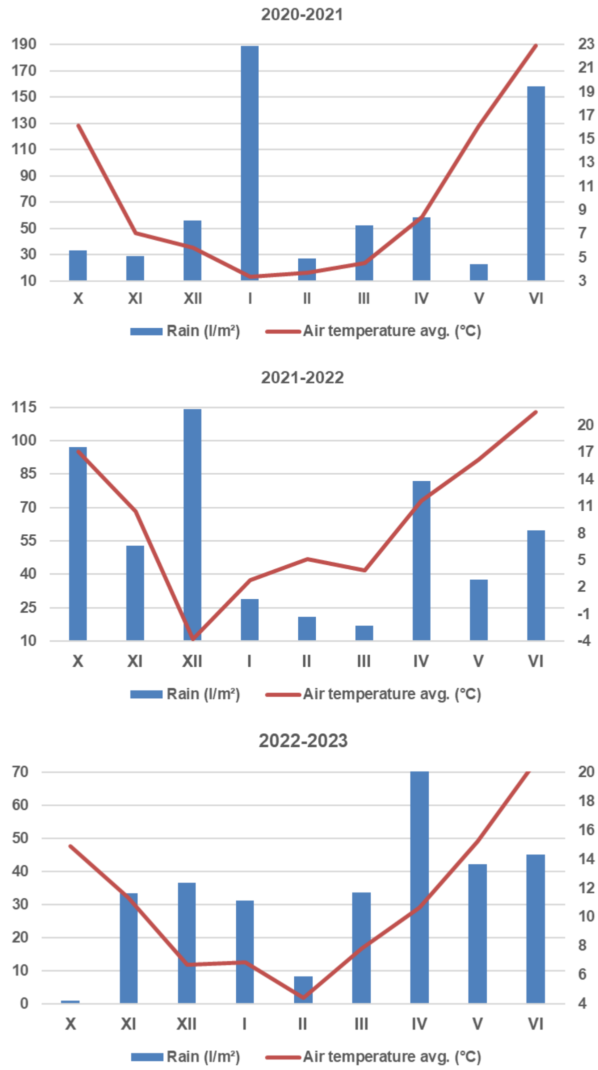

Figure 1. Meteorological conditions during the studied years.

A bivariate statistical analysis was performed to determine the effect of year and variety conditions, as well as the interaction between them (Table 2). The independent action of both factors has been statistically proven for almost all the investigated indicators. In the study, wheat was grown organically and environmental conditions were a major factor influencing the formation of productivity and quality. The conditions of the year have the most pronounced influence on the hectoliter mass (Test Weight). Genotype type has the greatest effect on 1000 grain weight (M 1000). The interaction between the two factors has a greater impact on quality indicators. These results have been established in our previous publications and studies by many other authors (Ivanova & Tsenov, 2010; Ivanova et al., 2013; Berberich et al., 2019; Marinciu et al., 2021; Ivanova et al., 2023; Chetan et al., 2024).

Table 2. Multifactor Analysis of Variance.

Signs / Source of variation	**Yields**	**LMS**	**WGS**	**M 1000**
Year (A)	43,07 0,000	6,63 0,030	282,04 0,000	4,15 0,074
Variety (B)	0,92 0,374	5,97 0,050	63,46 0,000	21,83 0,003
A x B	0,288 0,759	0,776 0,501	35,069 0,000	4,205 0,072
	Test Weight	**Protein**	**Starch**	**Ash**
Year (A)	4284,10 0,000	23,19 0,002	107,93 0,000	3,09 0,119
Variety (B)	163,33 0,000	11,19 0,016	73,31 0,000	9,87 0,020
A x B	35,233 0,000	3,134 0,117	0,812 0,487	3,093 0,119

During the studied years, different average values of the studied signs were obtained (Table 3).

Table 3. Average values of the investigated signs by years.

Signs / Year	**Yields**	**LMS**	**WGS**	**M 1000**
2021	5,205 b	9.35 a	1,864 b	38,71 a
2022	5,786 b	9.90 b	2,246 c	40,67 ab
2023	2,805 a	9.40 a	1,316 a	41,33 c
	Test Weight	**Protein**	**Starch**	**Ash**
2021	82,5 b	11,37 b	64,27 a	1,731 a
2022	73,5 a	12,41 c	67,26 b	1,663 a
2023	73,5 a	10,03 a	70,21 c	1,700 a

* Values with the same letter are not differ significantly

The most distinct differences according to the environmental conditions were in grain weight in one spike (WGS), weight of 1000 grains (M 1000), protein and starch content, falling into separate statistically significant groups. Differences between spike length (LMS) and ash content between years were insignificant. The resulting grain yield was highest in the second year of the study (2021-2022), while in the following year it was about 50% lower. The combination of meteorological factors in the second year (2021-2022) has proven to be most favorable for the formation of maximum productivity and quality of wheat.

On average for the studied years, the two varieties of wheat differ according to the studied indicators (Table 4). The obtained grain yield and its structural elements have similar values for both genotypes. The differences are more significant in the quality indicators of the grain. Averaged over the three years of research, under the conditions of natural fertility of the field experience without application of fertilization, the Merilyn variety is superior in productivity and quality to the Nikodim variety.

Table 4. Average values of the investigated signs by varieties.

Years	**2021-2023**	
Signs / Variety	**Merilin**	**Nikodim**
Yields	4,732	4,465
LMS	9,72	9,38
WGS	1,936	1,681
M 1000	42,04	38,43
Test Weight	77,1	75,9
Protein	11,75	10,79
Starch	68,66	65,83
Ash	1,663	1,733

CONCLUSIONS

The combination of meteorological factors, the amount of precipitation and the dynamics of average daytime temperatures in the second year of the study (2021-2022) has the most favorable influence on the formation of maximum productivity and quality of wheat.

The Merilyn variety is superior in terms of productivity and quality to the Nikodim variety under the conditions of organic cultivation in the Varna region, on average over the three years of research.

The differences between the two studied varieties are greater in quality indicators (protein and starch content) than in the values of grain yield and its structural elements.

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