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STUDY REGARDING THE YIELD COMPONENTS AND THE YIELD QUALITY AT SOME WHEAT VARIETIES

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Abstract

Wheat is of particular interest for the Romanian growers because it has high ecological plasticity and ensures relative constant yields. Having into account that the wheat growers are interested in varieties that produce the highest yields with good milling and bakery value, the purpose of this paper is to highlight the yield, yield components and yield quality of nine winter wheat varieties in the conditions of the reddish preluvosoil from the Romanian Plain. In this respect, under the specific climatic conditions of the 2018-2019 agricultural year, nine Romanian and foreign wheat varieties were tested under rainfed conditions on reddish preluvosoil within a field experiment in the Crop Production Didactic Field belonging to the Faculty of Agriculture, University of Agronomic Sciences and Veterinary Medicine of Bucharest.
The following determinations were performed: number of ears per m^2; number of grains per ear; weight of grains per ear; thousand grain weight – TGW (g); grain yield (kg/ha) reported at 14% moisture content; grain test weight (kg/100 l); protein content (%); wet gluten content (%).
The yielding capacity of a given wheat variety, which is determined by the values of the yield component, as well as the yield quality which is determined by several indicators are important traits in making growers to choose the variety to be cultivated.

Key words: *wheat, yield, yield components, yield quality.*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important crop species in the world, being cultivated according to FAO database on an area which varied after 2010 year from 215.4 to 223.8 million hectares. It is grown all over the world for its wider adaptability and high nutritive value (Patel et al., 2018).
Wheat is of particular interest for the Romanian growers because it has high ecological plasticity and ensures relative constant yields. In Romania, wheat is grown on an average area of about 2 million hectares annually, with an annual variation after 2010 year from 1.95 to 2.15 million hectares. The total wheat production in the last years in Romania exceeded 10 million tons.
The wheat yield in Romania varied annually after 2010 year from 2,659 to 4,888 kg/ha under the influence of genetics used by growers (variety or hybrid), pedoclimatic conditions (soil, climatic factors, climatic accidents) and technological factors (mainly crop rotation, fertilization strategy, soil tillage, seed quality and sowing conditions, control of weeds, diseases and pests, harvesting conditions).
According to the data published by the Association of Romanian Maize Growers (2019), which tested 36 Romanian and foreign wheat varieties in five different soil and climatic conditions from Romania in the 2018-2019 agricultural year, the yield varied from 3,479 to 10,393 kg/ha.
Among all wheat traits, yield is one of the most complex and economically important character (Yousif et al., 2015).
The yield of the wheat varieties occurs due to the interaction between the varieties, which are defined by specific genetic characteristics, and the soil and climatic conditions, as well as the crop technology which is aimed at mitigating the effect of the limiting factors on yield components and yield quality (Dumbravă, 2004).
The environmental conditions have a considerable influence on yield components in relation to varieties (Mustățea et al., 2008). The

environmental impacts have a significant effect on grain yield, as well as on quality traits (Egesel et al., 2012).

Along with genetic factors, technological factors and above all, mineral fertilization is an important way to increase and stabilize the yield of winter wheat production (Dragomir, 2019).

The considerable plasticity of wheat in reaching final yield is dynamically determined by three yield components: ear number per square meter, grain number per ear, and 1000-grain weight (TGW) (Yang et al., 2018). The number of ears per unit ground area (ear density) is one of the main agronomic yield components in determining grain yield in wheat (Fernandez-Gallego et al., 2018). The grain number per ear mainly contribute to a better grain yield with some contribution by spike length as well (Mohsin et al., 2009). Among the three important components of yield in wheat, TGW is probably most influenced by the environment conditions (Kumar et al., 2019).

The quality of wheat for milling and bakery is influenced by the interaction between varieties, the environmental conditions, the applied crop technology and the effect of some climatic accidents (Dumbravă et al., 2012).

The wheat growers are interested in varieties that produce the highest yields with good milling and bakery value. Having into account this, the purpose of this paper is to highlight the yield, yield components and yield quality of nine winter wheat varieties in the conditions of the reddish preluvosoil from the Romanian Plain.

MATERIALS AND METHODS

Researches were conducted in 2018/2019 agricultural year within a field experiment in the Crop Production Didactic Field belonging to the Faculty of Agriculture, University of Agronomic Sciences and Veterinary Medicine of Bucharest. A number of nine winter wheat varieties were studied, respectively Izvor, Glosa, Otilia, Pajura, Miranda, Anapurna, Avenue, Sorrial, Rubisko, under rainfed conditions on reddish preluvosoil. Micro plots of 10 m^2 were used for each variety in three replications.

From a climatic point of view, the agricultural year 2018-2019 in the area the field experiment was performed is characterised as being warmer than normal years and more dryer in the cold season and beginning of spring, but with rainfalls in the second part of spring and beginning of summer.

Crop management. The preceding crop was peas and the soil tillage practices were the classic ones.

The sowing density was of 500 grains/m^2. The grains were treated with Yunta Quattro 373.4 FS product based on clothianidin (166.7 g/l) + imidacloprid (166.7 g/l) + prothioconazole (33.3 g/l) + tebuconazole (6.7 g/l).

Fertilization was performed as follows:

- 18:46:0 fertilizer applied upon sowing, in a rate of 100 kg/ha;
- 26:13:13 fertilizer applied in early spring, in a rate of 100 kg/ha;
- NH_4NO_3 fertilizer applied at the stem elongation stage, in a rate of 100 kg/ha;
- Folimax Gold fertilizer applied upon occurrence of the last leaf, in a rate of 3 l/ha.

Weed control was carried out in the first decade of April using Rival Super Star 75 GD (37.5% chlorsulfuron + 37.5% tribenuron-methyl) herbicide in a rate of 20 g/ha.

Two fungicide products were used for controlling the diseases, respectively: Falcon Pro 425 EC (53 g/l prothioconazole + 224 g/l spiroxamine + 148 g/l tebuconazole), applied in a rate of 0.6 l/ha in April, and Prosaro 250 EC (125 g/l prothioconazole + 125 g/l tebuconazole), applied in a rate of 0.75 l/ha, at the boot stage.

Pest control was carried out by using Karate Zeon (50 g/l lambda-cyhalothrin) insecticide, which was applied in a rate of 0.15 l/ha, first application at the stem elongation stage and the second one upon occurrence of the ear.

Crop irrigation was carried out in 2 stages: after sowing, using 250 m^3/ha of water and at the stem elongation stage, using 500 m^3/ha of water.

Determinations. The following yield components were analysed upon harvesting: number of ears/m^2; number of grains/ear; weight of grains/ear; thousand grain weight (TGW).

Grain yield was calculated and expressed in kg/ha, this being reported at 14% moisture content of the grains.

Grain samples of 1 kg per each variety were taken and analysed in laboratory in order to determine the grain test weight, the protein content and the wet gluten content. These indicators are taken into consideration upon wheat selling and reflect the commercial and technological value for milling and bakery. The Inframatic Grain Analyzer equipment from Perten Instruments was used to determine these indicators.

The obtained data were statistically processed using the analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

The number of ears per m^2

The analysis of yield components indicates that the number of ears per m^2 for the studied varieties was on average of 511, with large variations between the varieties (Figure 1).

Anapurna variety with 551 ears/m^2 registered a difference distinct significant compared to average value of the studied varieties, this being followed by Avenue variety, with 545 ears/m^2, and Glosa variety, with 541 ears/m^2.

The lowest ear densities were registered for Pajura (462 ears/m^2) and Miranda (478 ears/m^2) varieties, which registered a difference negative distinct significant respectively negative significant compared to average value of the studied varieties.

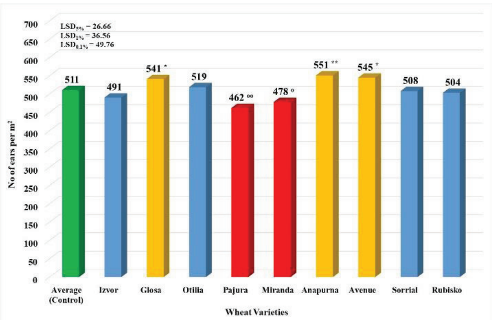

Figure 1. The number of ears per m^2 at the analysed wheat varieties

The number of grains per ear

The number of grains per ear is influenced by the number of ears/m^2, the growing conditions from the vegetation period, especially the climatic ones, and the crop technology.

The average number of grains per ear for the studied varieties was 32 (Figure 2). The Anapurna variety with 38 grains/ear registered a significant difference compared to average value of the studied varieties. This was followed by Sorrial variety with 34 grains/ear and Pajura with 33 grains/ear, but without significant differences compared to average value of the studied varieties.

Most varieties registered 31 grains/ear.

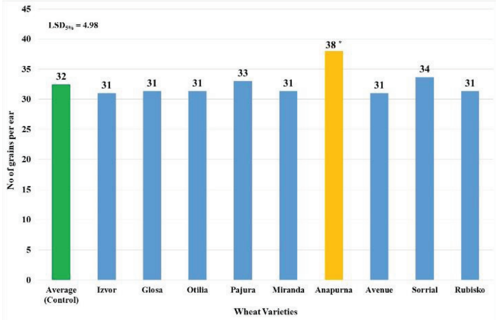

Figure 2. The number of grains per ear at the analysed wheat varieties

The weight of grains per ear

The weight of grains per ear is influenced by the number of ears/m^2 and by the certain limiting factors, such as deficiencies in nitrogen nutrition, the water stress, the excessive temperatures, the temperature differences between day and night during the grain formation and filling period, the foliar and ear diseases and the attack of certain pests.

The average weight of grains per ear for the studied varieties was of 1.29 g, with a large variation between varieties (Figure 3).

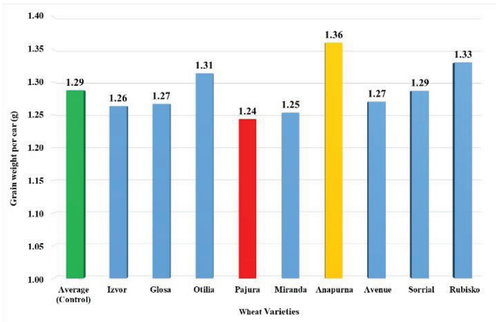

Figure 3. The weight of grains per ear at the analysed wheat varieties

The Anapurna variety with 1.36 g/ear registered the highest value of the weight of grains per ear, but without a significant difference

compared to average value of the studied varieties. High values of the weight of grains per ear have registered also the varieties Rubisko (1.33 g/ear) and Otilia (1.31 g/ear).
The lowest values of the weight of grains per ear were registered at the varieties Pajura (1.24 g/ear) and Miranda (1.25 g/ear).

Thousand grain weight (TGW)
The TGW is a genetic characteristic of the variety, but it is influenced by the ear density per m^2, the number of grains per ear, the weight of grains per ear and the effect of certain limiting factors during the grain formation and filling period, such as the presence of the foliar and ear diseases, the attack of certain pests, the thermal and water stress, the nutrition deficiencies.
For the studied varieties, the TGW registered an average value of 40.5 g, with obvious variations between varieties (Figure 4).
The Anapurna variety with a TGW of 43.94 g registered a significant difference compared to average value of the studied varieties, this being followed by the varieties Otilia with 42 g, Sorrial with 41.18 g, and Izvor with 41.15 g, but without significant differences compared to average value of the studied varieties.
The lowest values of TGW were registered at the varieties Avenue (37.67 g) and Rubisko (38.17 g).

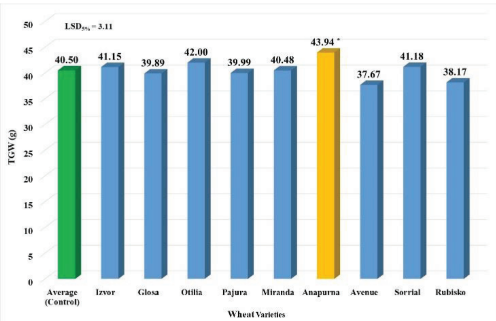

Figure 4. Thousand grain weight (TGW) at the analysed wheat varieties

Yield
The grain yield of a given variety is considerably influenced by the soil and climatic conditions specific to the area and the year of cultivation, the fertilisation strategy, the photosynthetically active leaf area, the preceding crop, the vegetation conditions in autumn, in early spring and until harvesting, the lack of some climatic accidents and the harvesting conditions.
The grain yield is the most synthetic indicator of variety agronomical value assessment.
The average yield of the studied varieties was of 6,618 kg/ha (Figure 5).
The highest yield was registered at the Anapurna variety, with 7,498 kg/ha and with a very significant difference compared to average value of the studied varieties. A significant difference compared to average value of the studied varieties was registered at the Sorrial variety, with 7,035 kg/ha. High yields were registered also at the varieties Glosa (6,862 kg/ha), Avenue (6,839 kg/ha) and Otilia (6,751 kg/ha), but without significant differences compared to average value of the studied varieties.
The lowest yields were registered at the varieties Izvor (6,202 kg/ha), Miranda (6,002 kg/ha), and Pajura (5,806 kg/ha), with negative significant difference compared to average value of the studied varieties for Izvor variety, respectivelly with negative very significant difference for Miranda and Pajura varieties.

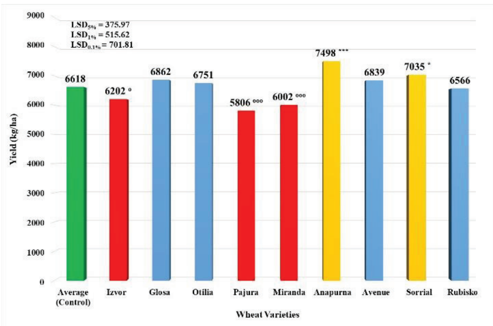

Figure 5. Yield at the analysed wheat varieties

Yield quality
The grain test weight (kg/100 l) reflects the commercial and technological value of wheat and it is taken into consideration for the payment calculation, wheat gradation, storehouse partitioning and baking value establishment.
The grain test weight of a given variety is influenced by the specific soil and climatic conditions of the cultivation area, the crop technology, the presence of foliar diseases, the pest attack, the grain chemical composition and the state of the grains upon harvesting (impurity content, the percentage of broken grains).

The average grain test weight for the studied varieties was of 76.1 kg/100 l, with variations between the varieties (Figure 6).
The highest values of the grain test weight were registered at the varieties Glosa (77.5 kg/100 l) and Avenue (77.1 kg/100 l). Good values of the grain test weight were registered also at the varieties Anapurna (76.3 kg/100 l), Izvor (76.2 kg/100 l), and Miranda (76.1 kg/100 l).
The lowest values of the grain test weight were registered at the varieties Rubisko (74.9 kg/100 l) and Pajura (75.5 kg/100 l).

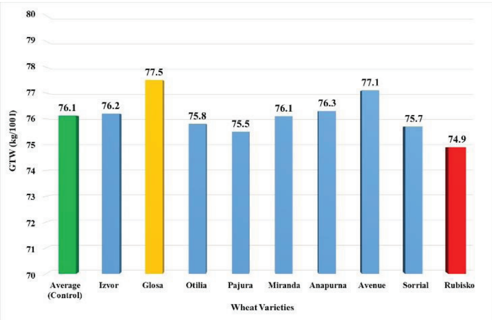

Figure 6. Grain test weight (GTW) at the analysed wheat varieties

The protein content reflects the wheat bakery quality and is taken into consideration in wheat gradation, in partitioning and in the establishment of the yield destination.
Protein is the main quantitative factor determining the quality of wheat grains; in this connection, factors that affect protein levels are of particular importance (Stoyanova et al., 2019). But, it has to be taken into account that along with protein concentration, protein quality is an important factor to determine the end use of the wheat (Egesel et al., 2012).
The protein content of a given variety is influenced by the specific soil and climatic conditions, the fertilisation strategy, the presence of diseases and pests, the climatic conditions and climatic accidents, as well as the harvesting conditions.
The protein content of the studied varieties was on average of 12.8%, with small variations between the varieties (Figure 7).
Glosa variety with a protein content of 13.3% registered the highest value, this being followed by varieties Miranda with 13.2%, Pajura with 13.1%, and Otilia with 13.0%.

The smallest values of the protein content were registered at the varieties Rubisko and Avenue, with 12.3%, and Sorrial variety, with 12.5%.

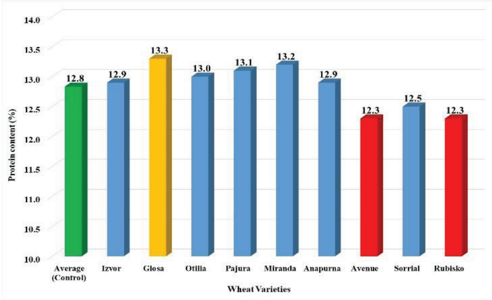

Figure 7. The protein content at the analysed wheat varieties

The wet gluten content reflects the bakery value and the quality of gluten influences the dough rheological characteristics and the commercial look of the bread (Figure 8). The gluten content of wheat is a critical factor in bread making and high gluten content of wheat is associated with good bread making characteristics (Delibaltova & Dallev, 2018).
The wet gluten content of the studied varieties was on average of 24.3% (Figure 7).
Glosa variety with a wet gluten content of 26% registered the highest value, this being followed by varieties Izvor, Otilia, Pajura, and Anapurna, all with a wet gluten content of 25%.
The smallest values of the wet gluten content were registered at the varieties Rubisko (22%) and Sorrial (23%).

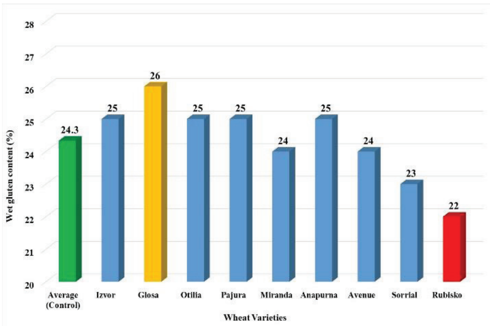

Figure 8. The wet gluten content at the analysed wheat varieties

Based on the quality indices analysed, the varieties Glosa, Pajura, Otilia, and Anapurna can be characterised as being very good for milling and bakery, while the other tested varieties can be characterised as being good for milling and bakery.

CONCLUSIONS

The yielding capacity of a given wheat variety, which is determined by the values of the yield component, as well as the yield quality which is determined by several indicators are important traits in making the growers to choose which variety to cultivate.

Because of the successive formation of the yield components (number of plants/m^2, number of tillers/m^2, number of ears/m^2, number of spikelets/ear, number of grains/ear and thousand grain weight - TGW), the yielding capacity of the varieties has to be assessed throughout the vegetation phases, from the crop settlement in the field to the grain filling stage.

The number of ears/m^2 is a result of the tillering process and the competition in the plant population for water, light, nutrients, diseases and pests during the stem elongation stage.

The number of grains/ear is formed from the beginning of stem elongation and ends upon flowering and correlates with the dry matter accumulated in the ear and the competition with other organs of the plant. The optimal conditions for the formation of a large number of grains/ear are: the reduced competition in the plant population upon stem elongation, flowering and grain formation; the absence of thermic stress; the absence of the water deficit; the non-limiting global radiation.

The thousand grain weight (TGW) is influenced by the water stress upon grain formation stage, the number of ears/m^2, the nitrogen nutrition, and the photosynthetically active leaf area.

The grain test weight is influenced by the grain size and uniformity, the impurity content and the nature of impurities, the grain chemical composition and it is a commercial indicator.

The protein content is influenced by the environmental conditions, the fertilisation strategy, and foliar diseases.

The wet gluten content is influenced by the protein content, the plant nutrition, and the environmental conditions. This quality trait has a considerable influence on the wheat bakery value.

REFERENCES

Delibaltova, V., Dallev, M. (2018). Investigation on the yield and grain quality of common wheat (*Triticum aestivum* L.) cultivars grown under the agroecological conditions of central Bulgaria. *Scientific Papers. Series A. Agronomy*, *Vol. LXI(1)*, 194–198.

Dragomir C.L. (2019). Effect of different nitrogen doses in different winter wheat production. *Scientific Papers. Series A. Agronomy*, *Vol. LXII*(1), 272–277.

Dumbravă, M. (2004). Tehnologia culturii plantelor. *Editura Didactică şi Pedagogică, Bucuresti*, 21–68.

Dumbravă, M., Dobrin, I., Dobrinoiu, R.V., Vişan, L. (2012). The management of the factors which influence the quality parameters of wheat imposed by the processors in the milling and bakery connection. *Romanian Biotechnological Letters, 17*(2), 7212–7217.

Egesel, C.Ö., Kahrıman, F., Tümer, A.İ., Çolak, Ç. (2012). Yield and quality characteristics of some foreign bread wheat (*Triticum aestivum* L.) cultivars in Turkey. *Romanian Agricultural Research, 29,* 31–38.

Fernandez-Gallego, J.A., Kefauver, S.C., Gutiérrez, N.A., Nieto-Taladriz, M.T., Araus, J.L. (2018). Wheat ear counting in-field conditions: high throughput and low-cost approach using RGB images. *Plant Methods*, 14: 22.

Kumar, A., Mantovani, E.E., Simsek, S., Jain, S., Elias, E.M., Mergoum, M. (2019). Genome wide genetic dissection of wheat quality and yield related traits and their relationship with grain shape and size traits in an elite × non-adapted bread wheat cross. *PLoS ONE*, *14*(9): e0221826.

Mohsin, T., Khan, N., Naqvi, F.N. (2009). Heritability, phenotypic correlation and path coefficient studies for some agronomic characters in synthetic elite lines of wheat. *Journal of Food, Agriculture and Environment*, *7*(3&4), 278–282.

Mustăţea, P., Săulescu, N.N., Ittu, G., Păunescu, G., Voinea, L., Stere, I., Mârlogeanu, S., Constantinescu, E., Năstase, D. (2008). Response of several winter wheat cultivars to contrasting environmental conditions. *An. I.N.C.D.A. Fundulea, 76*, 7–14.

Patel, M.D., Dabhi, M.S., Patel, A.K., Desai, H.A., Chatra Ram (2018). Response of Wheat Varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to Sowing Time. *International Journal of Current Microbiology and Applied Sciences*, *7*(10): 1555–1561.

Stoyanova, A., Ganchev, G., Kuneva, V. (2019). Assess of the impact of fertilization on wheat protein and energy nutrition. *Scientific Papers. Series A. Agronomy*, Vol. *LXII*(1), 443–449.

Yang, X., McMaster, G.S., Yu, Q. (2018). Spatial Patterns of Relationship Between Wheat Yield and Yield Components in China. *International Journal of Plant Production*, 12:61–71.

Yousif, S.A., Jasim, H., Abas, A.R., Yousef, D.P. (2015). Some Yield parameters of wheat genotypes. *World Acad Sci Eng Technol Int J Biol Biomol Agric Food Biotechnol Eng*, *9*, 323–326.

***, (2019). Testări cereale păioase – Rezultate R.I.T.A.C. Association of Romanian Maize Growers – APPR.

http://www.fao.org/faostat/en/#data/QC