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PRODUCTIVITY OF SERBIAN WHEAT GENOTYPES GROWN IN ECOLOGICAL AGRICULTURAL SYSTEM

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SUMMARY: Due to strict rules in ecological plant production, especially in case of fertilization and plants protection, productivity i. e. yield could be limited. Choosing the appropriate genotypes, modest requirements to the inputs and adapted to the conditions of ecological cultivation is a particularly important point and one of the prerequisites for economical, profitable and stable production, without big risks and losses. The aim of this paper was to estimate adaptability of wheat genotypes to ecological growing conditions according to grain yield. The trial was carried out in Center for Small Grains, Kragujevac, Serbia. 23 Serbian wheat genotypes were included. There were applied two fertilization variants (manure and NPK fertilizers) and control one, too. Mainly, NPK fertilizers caused statistically significant differences in grain yield. At the same time, manure influenced the increase of grain yield compared to the control variant. The genotypes that achieved similar yields, without significant differences in relation to applied fertilizers, were: Morava, Lepenica, Studenica, KG 100, Lazarica, Pobeda, Evropa 90, Perla, Pesma. Vizija was the more yielding in manure than in NPK variant. Those varieties are interested for practical cultivation in ecological agriculture and could be significant material in wheat breeding in order to obtain new varieties adapted to the ecological system of cultivation and sustainable agriculture.

KEY WORDS: ecological agriculture, fertilizers, wheat, yield.

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1. INTRODUCTION

The wheat (*Triticum aestivum* L.) is one of the most important crop whole the world, along with maize and rice Its use is, primarely, in human diet, but it is not negligible its role in feed, industry and other. Whatever, it is the key plant species in food security, over the world.

The most commonly grown crops in Serbia are maize and wheat, too. The total area under the wheat has changed due to many factors (social, economic, market and others). So, total area under cereals during 2018 was about 1.7 million hectares, but wheat took part in it with more than one third. Worldwide, wheat accounts for about one-third of the sown cereals area, too or about 26%. Harvested area under wheat, in period 2007 – 2018, varied from 556115 ha (2017) to 643083ha (2018), with observation that it did not fall below the level of 600000ha, in period 2007 – 2014 (Grčak et al., 2020). According to the latest data (https://publikacije.stat.gov.rs/G2023/HtmlL/G20231019.html) wheat was sown, in the autumn sowing, on the 665718ha that is 13,6%. more than in 10 years average for autumn sowing.

Nowadays, contemporary agriculture and, consequently, wheat production meets new requirements and challenges that are, seemingly, strongly opposed: supply enough food amounts for growing human population and, at the same time, reach the required level of sustainability, in the broadest sense of the word. It means that grain yield of wheat has to go up that, furthermore, demands more intensive production and more inputs which threatens the sustainability of production. At the global level, yield improvement of wheat has stagnated and, even, declined over recent decades, despite the fact that the growing area are increasing. Wheat grain yield can vary from 1 t ha $^{-1}$ to more than 10 t ha $^{-1}$, but, mostly, winter wheat obtains around 3 to 7 t ha $^{-1}$. The latest projection in EU (soft wheat) of 5.76 t ha $^{-1}$ is below the five-year average (5.84 t ha $^{-1}$) (https://www.ers.usda.gov/webdocs/publications/43783/39922). The average wheat grain yield in Serbia, in period 2007 – 2018, ranged from 3.4 t ha $^{-1}$ (2010) to 4.8 t ha $^{-1}$ (2016) (https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl). In season 2022, the realized wheat grain yield was 4.9 t ha $^{-1}$, with the fact that varied from 4.0 t ha $^{-1}$ (South of Serbia) to 5.4 t ha $^{-1}$ (Vojvodina) (https://publikacije.stat.gov.rs/G2023/HtmlL/G20231019.html)

Due to the fact that projected yield gains fall below the predicted future grain demand, it is important to emphasize that grain production increases between 35%–56% are needed to meet the projected global food demand by 2050 (Guarin et al., 2022). Wheat grain yield is affected by many

factors: variety type, soil and climate conditions, applied technology of grow and management practices and each of them contributes to both the amount and quality of yields. Many of studies (Mehmood et al., 2018; Hong-zhu et al., 2019; Kihara et al., 2022; Wójcik-Gront et al., 2022) have found that fertilizing is the main factor for maximizing wheat yield. At the same time, many authors (Lu et al., 2017; Tahat et al., 2020; MacDonald et al., 2021; Romero et al., 2021) have emphasized the fertilization intensification of the last decades has caused new global environmental and geopolitical problems (nutrient imbalances, environmental and food safety risks, increasing cost of fertilizers, food security in poor countries) directly threatening the sustainability and ecological acceptability of agriculture i. e. wheat production. Agricultural sustainability, defined as the ability to use soil crops to produce continuous food without environmental degradation and risks proposes a large list of new or changed practices that can be applied, promoting new production methods and models. Farming practices have shown that organic and/or regenerative farming with conservation tillage, manual and biological weeding and pest control and use of farming and crop waster as fertilizers to reduce the need to apply industrial fertilizer, smart intercrop and crop rotation managements; all them improving soil health and, consequently, efficiency of productivity and sustainability (Penuelas et al., 2023). Optimization of fertilization is recognized as an important tool for reconciling two contradictories, above mentioned, requirements: yield and sustainability, with environmentally friendly production model. There are though several new technologies and crop management methodologies that can help to achieve that goal. Smart, precision and regenerative agriculture approaches together with new biotechnologies application and new legislation adopting the well-known and common-sense 4R principle would help to ensure the appropriate use of fertilizers and the optimization of crop productivity for food security and environmental sustainability (Penuelas et al., 2023).

One of ways to get over this "conflict" and achieve satisfactory level of sustainability and ecological acceptability of wheat production is selection and breeding genotypes with improved efficiency of nutrient uptake and utilization that need program based on physiological parameters as criteria (Nikolic and Pavlovic, 2019; Guarin et al., 2022). It leads to getting varieties adapted to cultivation in conditions of suboptimal nutrient supply or without the use of chemical fertilizers, able to achieve their genetic maximum for yield, in such conditions.

The aim of this study is to investigate yielding of Serbian wheat genotypes in various fertilization variants and identify such ones could be desirable in: a) sustainable agricultural practice and b) selection and breeding of wheat like carriers of desirable genes regarding to obtaining new genotypes in accordance with the requirements of modern, sustainable agriculture.

2. MATERIAL AND METHOD

2.1. SOIL AND METEOROLOGICAL CONDITIONS DURING EXPERIMENT

The study was carried out on the property of the Small Grains Research Center in Kragujevac city (181 m.a.s.l.) in Serbia, during the season 2017/18. The soil type was smonitza in degradation (Vertisol).

The average temperatures and monthly precipitation during the wheat vegetation period (October 2017-June 2018) and the 30 years mean (1981-2010) are shown in Table 1.

Table 1: Monthly temperatures and precipitation during season 2017/18 and 30 years means (LTM)

Month	Monthly temperatures (°C) 2017/18				Monthly amounts of precipitation 2017/18		
	min	max	average	LTM	Rainfall (mm)	LTM	Snow (cm)
X	6.5	19.7	13.1	11.40	95.8	48.9	-
XI	3.5	12.3	7.9	5.90	19.3	49.5	-
XII	0.6	8.6	4.6	2.13	57.0	45.8	4
I	- 0.4	8.7	4.2	5,2	49.9	37.9	4
II	- 1.1	6.0	2.5	7,3	62.2	37,0	19
III	1.9	11.6	6.8	12,5	93.7	42.3	10
IV	9.4	23.3	16.4	17,8	25.8	53.9	-
V	11.7	26.2	18.9	23,0	52,6	58.7	-
VI	15.4	27.0	21.2	26,1	95.6	76.4	-
average	6.0	18.0	12.0	14.0	Total: 551.9	450.4	37

Agrometeorological conditions during 2017/2018. season were very favorable for most agricultural species. In general, year 2017, with average air temperature 11.5°C has been 12th the warmest year in Serbia, through period from 1951. up today. Air and soil temperatures during October 2017. were favorable for sowing, germination, sprouting and earlier phases of development of winter crops. In great part of country, October 2017 was average warm and rainy, as entire autumn (https://www.hidmet.gov.rs/data/klimatologija/latin/2017.pdf). Year 2018, even, was year of climate records, especially in case of temperatures (average year temperatures 12.0 °C). It was the warmest year in period 1951. up to now and the warmest in Belgrade (average year temperatures 14.5 °C) from beginning meteorological station work (1888). In the great part of country, 2018. was averagely rainy. Vary and extremely rainy was in west, north east and central part of Serbia. The highest rainfall was registered in June (Table 1). One more the specificity of this year was April as the warmest in Serbia for whole period meteorological measurements have been carried out (https://www.hidmet.gov.rs/data/agro/AGROveg2018.pdf).

2.2. MATERIAL AND METHOD OF EXPERIMENT

The experiment included 23 wheat cultivars, originating from the Serbia: Small Grains Research Center, Kragujevac (Morava, Studenica, Takovčanka, Toplica, Srbijanka, KG 100, Lazarica, Bujna, Matica, Vizija, Lepenica, Perla, KG 10) and Institute of Field and Vegetable Crops, Novi Sad (Pobeda, Rana 5, Evropa 90, Renesansa, Tiha, Mina, Prima, Kremna, Rusija, Pesma).

The basic processing and pre – sowing preparation of the soil was done using standard procedures. The randomized complete block experimental design was used with five replicates in rows 1.5m on, for each fertilization variant, with spacing between rows of 0.20m. Sowing (200 grains per row) was done by hand (one genotype per row), during the optimal planting period for central Serbian conditions, for winter wheat (29. 10. 2017). Applied fertilization variants were: control (without any fertilizer), NPK (8:24:16) variant (300kg ha^{-1}, before sowing + 260kg KAN ha^{-1}, at tillering stage) and manure variant (10t cattle manure per hectare, before sowing).

Plant samples of each genotype were taken at maturity (five plants per replication, for each fertilization variant). The samples were air – dried and grain yield (GY, g m^{-2}) was measured by standard method.

Averge values and test of significance were determined according to Dahiru (2008).

3. RESULTS AND DISCUSSION

Production and use of chemical fertilizers, which started at the middle of the last century, has presented turning point in agriculture in terms of yield increase, stability and quality of yield. FAO estimated that the share of chemical fertilizers in increasing the yield of cultivated plants is between 50 and 60%. Therefore, most of the examined cultivars obtained the highest yield in NPK variant (Table 2). The grain yield in that variant varied from 586.05g m^{-2} (Lazarica) to 1171.60g m^{-2} (KG 10). At the same time, the lowest yield in variant with manure was 412.55g m^{-2} (Renesansa), but genotype KG 10 achieved the highest one (989.64g m^{-2}). The same genotype was the most productive in control variant (917.58g m^{-2}) while Pesma achieved the lowest yield (216.77g m^{-2}). KG 10 was, averagely, the highest yielding genotype (1026.27g m^{-2}) while the lowest yielding (425.41g m^{-2}) one was Prima. KG 10 was statistically high significant above the average and most of other studied genotypes (Table 2).

From the aspect of ecological and sustainable agriculture, it is very important to analyze the yield of wheat grains in NPK and manure variants and differences between both of them. Average, the grain yield was 502.60g m^{-2}, 725.71g m^{-2} and 627.01g m^{-2} in control, NPK and manure variant, respectively. The differences were statistically high significant between control and NPK variant, but statistically significant between control and manure ones (Table 2).

Table 2: Average values of grain yield of wheat (g m^{-2}), in various fertiliaztion variants

Genotype	Fertilization variant			average
	control	NPK	manure	
Morava	598.19	942.69	825.73	788.87
Lepenica	341.13	708.46	607.99	552.53
Studenica	469.30	775.61	753.01	651.07
Takovčanka	518.91	785.15	649.15	687.88
Toplica	449.55	612.79	441.63	501.32
Srbijanka	431.90	730.47	569.06	577.14
KG – 100	666.50	711.58	679.79	685.96
Lazarica	398.10	586.05	557.71	513.95
Bujna	439.73	606.47	480.26	508.82
Matica	609.92	770.69	645.46	675.36

Vizija	643.42	708.75	**769.22**	707.13
Pobeda	509.12	699.41	632.63	613.72
Rana 5	451.91	765.12	606.93	607.99
Evropa 90	689.88	880.13	840.39	803.47
Renesansa	374.36	666.88	412.55	484.60
Tiha	398.00	739.56	540.33	559.30
Mina	626.17	778.87	716.88	707.31
Prima	227.77	631.13	417.32	425.41
Kremna	469.43	633.81	559.01	554.08
Rusija	419.11	773.95	748.58	647.21
Pesma	216.77	599.71	544.69	453.72
Perla	693.04	761.26	660.84	705.05
KГ 10	917.58	1171.60	989.64	1026.27
average	502.60	725.71	627.01	618.44
$LSD_{0.05}$	A 120,94	B 166,21	A x B 114,68	
$LSD_{0.01}$	127,57	187,19	151,01	

A = fertilization variant; B = genotype; A x B = interaction fertilization variant x genotype

All of investigated genotypes achieved higher grain yield in NPK variant compared to manure variant, except Vizija (708.75g m-2 in NPK and 769.22g m-2 in manure variant) (Table 2). It is important cultivar trait in term of agricultural practice and adaptability to ecological growing system where organic manure, as a cheap and easily available source of nutrients for most of the agriculture crops, with the slow release of nitrogen and potential to building of P and K in soil solution, plays key role. Besides that, grain yield differences between these two variants, at more than half of investigated genotypes (Morava, Lepenica, Studenica, KG 100, Lazarica, Pobeda, Evropa 90, Perla, Pesma,...) were not statistically significant. Even, there were genotypes (KG 100 and Perla) whose yield in the control variant was not statistically significantly lower compared to NPK (Table 2).

Many researchers found out strong effect of organic fertilizers on grain wheat yield, even more, additional strong effect on the long-term improvement of soil quality. Wang et al. (2020), noticed, based on field experiments conducted across a range of soils and growing environments in northern China, that use of organic fertilizer increased winter wheat grain yield and water use efficiency and reduced yield variability. The yield response to organic fertilizer was dependent on method of application and level of nitro-

gen in it. Zhou et al., (2022) registered the strong effect of organic fertilizer incorporation practices on crop yield, soil quality and fauna feeding activity from fluvo-aquic soils on wheat. In some season, there was no difference in the wheat yields between different organic fertilizer and traditional fertilization by mineral (NPK) fertilizer. The better results (wheat grain yield increase up 34.7 to 50.6%) gave combination of different organic and mineral fertilizers compared to only chemical fertilization treatment (400 N $kg \cdot ha^{-1}$). Analyzing various manure kinds (Jamal and Fawad, 2018), it was concluded that poultry manure is the most effective manure among all the manures used (cattle, sheep), moreover poultry manure had a dominant and positive effect on biological and grain yield of wheat crop as compared to other treatments used. Apaeva et al., (2021) suggested the production of granular organic fertilizers from poultry manure as tool for solve the problem of organic agriculture, reduce environmental risks from poultry farm waste, reduce the negative impact of mineral fertilizers on the soil and improve phytosanitary condition of the soil.

In the control variant, KG 100 achieved the statistically significant higher yield, while Evropa 90 and Perla showed statistically high significant better yielding in relate to average. In aspect of ecological and sustainable agriculture, adaptibility of genotype to optimal grow in fertilization free variant, even organic fertilization free, too, is very important. Actually, some studies (Allam, et al., 2022) showed that some agronomical practices, among them organic fertilization that are widely promoted for their agro-ecological benefits, do not always lead to productive agroecosystems. The final results depends on analysis of specific agro-environmental conditions, environmental and agronomical factors that need to be evaluated for a specific situation and understanding of their impact of these farming practices on crop productivity and the sustainability of the agroecosystems in a specific region. Brar et al. (2015) emphasized some disadvantages of organic fertilizers, too, like: potentially pathogenic and strict procedures of preparation, low level of nutrients content, difficult application. It is, however, indisputable numerous advantages, ecological, health, of organic fertilizers use. Nowadays, due to decrease of animal husbandry, the bigger problem, agricultural practise faces, is lack of manure. Based on all above mentioned, adaptibility of genotype to fertilization free conditions and stability of yield in spite of such growing conditions, has becoming more important trait. Beside already mentioned genotypes (KG 10, KG 100, Vizija, Perla), genotypes Toplica, Bujna, Matica, and Mina expressed such ability.

4. CONCLUSION

The studied wheat genotypes achieved, averagely, the highest grain yield in NPK variant (725.71g m^{-2}), followed by manure (627.01g m^{-2}) and control variant (502.60g m^{-2}). Although the majority of genotypes reacted positively to the application of chemical fertilizer, Vizija was the more yielding in manure than in NPK variant. Furthermore, the differences in yield between the NPK and the manure variant, in more than half of them (Morava, Lepenica, Studenica, KG 100, Lazarica, Pobeda, Evropa 90, Perla, Pesma) were not statistically significant. Even, KG 100 and Perla achieved yield in the control variant that was not statistically significantly lower compared to NPK. Beside these, genotypes Toplica, Bujna, Matica and Mina expressed an important stability of yield and adaptibility to free fertilization conditions, according to obtained results in ontrol variant and comparasion with other ones in trial.

Highlighted genotypes represent an assortment adapted to sustainable and ecological cultivation, without the risk of low yield and unprofitability. So, these results could be important recommendations for agricultural practice. On the base of these results, it could be performed further trials in aim to precisely investigate them as a potential source of desirable genes for the selection and breeding of wheat for conditions of sustainable and ecological cultivation.

5. BIBLIOGRAFY

[1] Allam, M. et al. (2022): Influence of Organic and Mineral Fertilizers on Soil Organic Carbon and Crop Productivity under Different Tillage Systems: A Meta-Analysis. Agriculture, 12(4): 464; https://doi.org/10.3390/agriculture12040464

[2] Apaeva, N. N. et al. (2021): Ecologized technology of spring wheat cultivation with application of granular organic fertilizers IOP Conf. Ser.: Earth Environ. Sci. 624 012217.

[3] Brar, B.S., Singh, J., Singh, G., Kaur, G. (2015): Effects of Long Term Application of Inorganic and Organic Fertilizers on Soil Organic Carbon and Physical Properties in Maize-Wheat Rotation. Agronomy, 5, 220-238.

[4] Dahiru, T. (2008): P -value, a true test of statistical significance? A cautionary note. Annals of Ibadan Postgraduate Medicine. 6: 21–26.

[5] Grčak, M. et al. (2020): The trends in maize and wheat production in the republic of Serbia Acta Agriculturae Serbica, 25 (50), 121-127.

[6] Guarin, J. R. et al. (2022): Evidence for increasing global wheat yield potentialEnviron. Res. Lett. 17 124045.

[7] Hong-zhu, C. et al. (2019): Identifying the limiting factors driving the winter wheat yield gap on smallholder farms by agronomic diagnosis in North China Plain. Journal of Integrative Agriculture, 18(8): 1701–1713.

[8] Jamall, A., Fawad, M. (2018): Application of different organic manures in optimizing optimum yield for wheat in calcareous soil. WNOFNS 20 (2018) 23-30.

[9] Kihara, J. et al. (2022): Understanding factors influencing wheat productivity in Ethiopian highlands. Experimental Agriculture, Online first paper (07 February 2022) 18 p. ISSN: 0014-4797.

[10] Linlin, W. et al. (2020): Winter wheat yield and water use efficiency response to organic fertilization in northern China: A meta-analysis. Agricultural Water Management. Volume 229. 105934.

[11] Lu, C., Tian, H. (2017): Global nitrogen and phosphorus fertilizer use for agriculture production in the past half century: shifted hot spots and nutrient imbalance. Earth Syst Sci Data. 9:181–92.

[12] MacDonald, G.K., Bennett, E.M., Potter, P.A., Ramankutty, N. (2021): Agronomic phosphorus imbalances across the world's croplands. PNAS. 108:3086–91.

[13] Mehmood, Q.M., Sail, riaz, M.H., Moeen, M. (2018): Identifying key factors for maximizing wheat yield: a case study from Punjab (Pakistan). Pakistan Journal of Agricultural Research, 31(4): 361-367. DOI | http://dx.doi.org/10.17582/journal.pjar/2018/31.4.361.367

[14] Nikolic, O., Pavlovic, M. (2019): The possibilities of use of the physiological efficiency of nitrogen in wheat breeding in term of ecological agriculture. Ratarstvo i povrtarstvo, Novi Sad. 56, 3:76-81.

[15] Penuelas, J., Coello, F., Sardans, J. (2023): A better use of fertilizers is needed for global food security and environmental sustainability. Agric & Food Secur 12, 5https://doi.org/10.1186/s40066-023-00409-5

[16] Romero, E. et al. (2021): The mediterranean region as a paradigm of the global decoupling of N and P between soils and freshwaters. Glob Biogeochem Cycl. 35:2020GB006874.

[17] Tahat, M.M., Alananbeh, K.M., Othman, Y.A., Leskovar, D.I. (2020): Soil health and sustainable agriculture. Sustainability. 12:4859.

[18] Wójcik-Gront, E., Iwa ´nska, M., Wnuk, A., Oleksiak, T. (2022): The Analysis of Wheat Yield Variability Based on Experimental Data from 2008–2018 to Understand the Yield Gap. Agriculture. 12, 32. https://doi.org/10.3390/agriculture 12010032

[19] Zhongkai, Z. et al. (2022): Effects of organic fertilizer incorporation practices on crops yield, soil quality, and soil fauna feeding activity in the wheat-maize rotation system Front. Environ. Sci., Sec. Soil Processes. Volume 10 - 2022 | https://doi.org/10.3389/fenvs.2022.1058071

Websites:

https://publikacije.stat.gov.rs/G2023/HtmlL/G20231019.html (visited 07. 08. 2023)

https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl (visited 07. 08. 2023)

https://www.hidmet.gov.rs/data/agro/AGROveg2018.pdf (visited 07. 08. 2023)

https://www.hidmet.gov.rs/data/klimatologija/latin/2017.pdf (visited 07. 08. 2023)

https://www.ers.usda.gov/webdocs/publications/43783/39922 (visited 10. 08. 2023)

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