12. JEEP MEĐUNARODNA NAUČNA AGROBIZNIS KONFERENCIJA-MAK 2025
12th JEEP INTERNATIONAL SCIENTIFIC AGRIBUSINESS CONFERENCE-MAK 2025
„Climate change and ecological sustainability in agriculture and food production in Serbia, the region and Southeast Europe"
SERBIA, KOPAONIK January 30th to February 2nd, 2025.

doi:10.46793/MAK2025.128MS

IMPACT OF FOLIAR FERTILIZATION ON GRAIN WEIGHT PER SPIKE IN DURUM WHEAT GROWN UNDER ORGANIC FARMING

Mirela Matković Stojšin[1*], Veselinka Zečević[2], Slobodan Milenković[3], Kristina Luković[2], Milan Stojšin[4], Dragana Stevanović[1], Desimir Knežević[5]

[1]Tamiš Research and Development Institute, Pančevo, Serbia
*matkovic.stojsin@institut-tamis.rs
[2]Institute for Vegetable Crops, S. Palanka, Serbia
[3]Educons University, Faculty of Ecological Agriculture, Sremska Kamenica, Serbia
[4]University of Novi Sad, Faculty of Agriculture, N. Sad, Serbia
[5]University of Priština temporary settled in Kosovska Mitrovica, Faculty of Agriculture, Lešak, Serbia

Abstract: The treatment with two foliar N applications (T3), was most effective in improving grain weight per spike in durum wheat genotypes. Genotype KG-3405-03 showed the highest grain weight under T3 in favorable 2013 conditions (1.91 g) but experienced the greatest decrease in 2014. In contrast, genotype KG-43-33/1 achieved the best results under T3 in the less favorable 2014 season (1.61 g), indicating its adaptability to adverse conditions, with foliar N fertilization. KG-28-6 and KG-44-3/1 are more stable and recommended for growing in various agroecological conditions.

Key words: Durum wheat, N treatment, Organic production, Genotypic variation

1. INTRODUCTION

Durum wheat (*Triticum turgidum* L. var. *durum* Desf.) ranks as the second most widely cultivated wheat species globally (Martínez-Moreno et al., 2022). According to International Grains Council (IGC, 2023), durum wheat is grown on approximately 13.7 million hectares worldwide, producing an average of 34.3 million tons of grain between 2018 and 2022. Although its global cultivation area is relatively small, durum wheat is a crucial crop and staple food in many Mediterranean regions, serving as the primary raw material for various traditional end-products such as pasta, couscous, bulgur, and different types of bread (Kabbaj et al., 2017).

Durum wheat is best suited to semi-arid, warm climatic conditions, so it is grown as a winter crop in Mediterranean regions. In colder areas with long winters, it is typically sown in spring and harvested in early autumn (Bassu et al., 2009; Sieber et al., 2014; Martínez-Moreno et al., 2022). In Central and Eastern Europe, particularly in the Pannonian region, most durum wheat varieties are winter types and are sown in the autumn (Vida et al., 2022).

Despite its good adaptability to dry and arid regions, durum wheat production is highly influenced by abiotic and biotic factors, especially drought and high temperatures (Pour-Aboughadareh et al., 2022; Grosse-Heilmann et al., 2024). Considering these challenges and the ongoing climate changes in recent years, the use of various agronomic practices has become increasingly important. These practices include adjusting tillage methods, implementing appropriate crop rotation, modifying sowing dates, and applying nitrogen fertilizers, which can increase yield and grain quality, but also pose environmental risks (Bassu et al., 2009; Knezevic et al., 2014; Morari et al., 2017; Bozek et al., 2021; Grosse-Heilmann et al., 2024). Therefore, organic fertilizers offer a more sustainable alternative and have been shown to improve soil quality and nutrient availability (Mancinelli et al., 2023). However, a limitation of organic fertilizers is the potential reduction in crop yield and quality (Di Mola et al., 2021). The aforementioned authors suggest that the impact of organic fertilizers on the yield and quality of durum wheat is site-specific, with a less pronounced effect on less fertile soils with high clay content.

Given the growing consumer demand for reliable products, especially those from organic production (Mie et al., 2017; Wang et al., 2019), organic durum wheat production has become a key focus due to the increasing interest in organic food (Zečević et al., 2022). Therefore, it is essential to select durum wheat varieties capable of producing high and stable yields, even in marginal envrionment conditions, for both organic wheat growers and breeders (Cséplő et al., 2024). Consequently, it is important to investigate diverse durum wheat genotypes within organic farming systems. Considering that optimizing nitrogen fertilization is a primary objective of applied agricultural research (Ercoli et al., 2013), further studies are needed to determine the optimal fertilizer combinations to improve durum wheat production (Zečević et al., 2022).

The aim of this study is to determine the impact of genotype, nitrogen fertilization treatments, season, and their interactions on the variability of grain weight per spike in durum wheat within an organic farming system.

2. MATERIAL AND METHODS

2.1. Plant material and experimental design

A field experiment was conducted using a randomized block design with three replications on a certified organic farm in Čačak, Serbia, during the 2012/2013 and 2013/2014 growing seasons. The plant material consisted of seven durum wheat genotypes, including three varieties: Windur (Germany), Žitka, and KG Olimpik (Serbia), along with four breeding lines: KG-28-6, KG-3405-03, KG-43-33-1, and KG-44-3-1 (Serbia). Each experimental plot was 5 m², and the soil type was classified as clay loam. The soil on which the experiments were conducted is acidic and classified as a carbonless soil type, with a low pH value and low free $CaCO_3$ content. The soil had a moderate level of organic matter and falls under the class of poorly humus soils. It has medium levels of readily available phosphorus and potassium. All soil analyses were performed at the Laboratory for Soil and Agroecology of the Institute of Field and Vegetable Crops in Novi Sad, Serbia, which is accredited according to the ISO/IEC 17025:2017 standard.

The experiment was conducted following the principles of organic wheat production. According to the Ordinance on Control and Certification in Organic Production in Serbia, maximum intake of 170 kg N ha^{-1} per year is allowed in organic farming. In the first season (2012/2013), potato was the preceding crop, and in the second season (2013/2014), processing crop was beans. In autumn, a starter fertilization was applied using 2 tons of organic fertilizer Italpollina (4:4:4) at a rate of 80 kg of pure nitrogen per hectare. Sowing was performed on November 2nd in the first season and October 25th in the second season, with a seeding rate of 600 seeds per square meter. During the tillering phase in February 2013, 500 kg per hectare of organic fertilizer Dix 10 (10:3:3) was applied, providing 50 kg of pure nitrogen per hectare. These fertilizers, produced by Hello Nature (formerly Italpollina, Italy), were used in the study. Three foliar nitrogen treatments were applied at different stages of plant development: T1 (no nitrogen application), T2 (one foliar spray of 0.3% organic fertilizer Trainer at the beginning of heading on April 10, 2013, and April 14, 2014), and T3 (two foliar sprays of 0.3% organic fertilizer Trainer at heading and anthesis stages, on May 8, 2013, and May 12, 2014), according to the recommended commercial rate. Grain weight per spike was analyzed in 10 randomly selected plants per main plot at full maturity, determined on the primary spikes.

2.2. Agro-meteorological conditions

Meteorological data were obtained from the Meteorological Station of the Fruit Research Institute in Čačak (Figure 1). In the first season (2012/2013), higher temperatures in April and May (13.2 °C and 18.2 °C) played a crucial role in significantly accelerating plant growth. In contrast, the 2013/2014 season was marked by lower average temperatures in November and December (7.3 and 0.5°C), which were below the long-term average, resulting in a delay in plant development. In the 2012/2013 season, the total amount of precipitation was 503 mm, which was higher than in the 2013/2014 season (413.8 mm). Precipitation in 2012/2013 was more evenly distributed throughout the year, with the highest rainfall in December (87.6 mm) and February (68 mm), which provided optimal conditions for early crop development. Although rainfall in April and May 2013 was lower (37 and 78.5 mm), it was still sufficient to support plant growth. In contrast, vegetation in the 2013/2014 season was affected by uneven precipitation distribution, with extremely high rainfall in May (167.8 mm) and June (149.8 mm), which negatively impacted plant health and crop maturity. In the same season, December, January, and February were characterized by very little precipitation or complete lack of it, which slowed down plant growth and development.

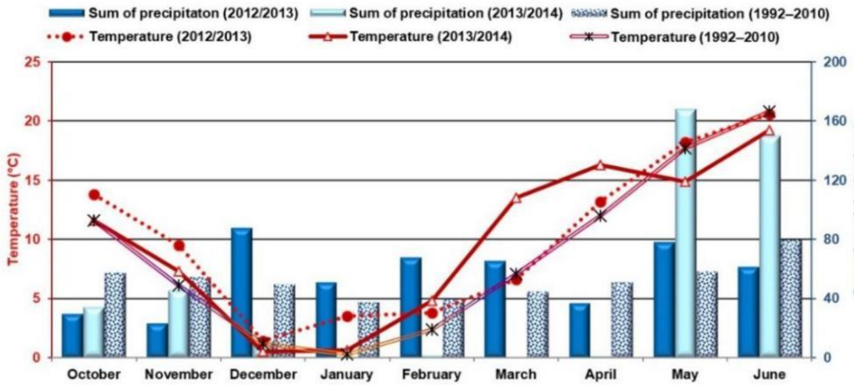

Figure 1. Meteorological conditions during the experiment

2.3. Statistical analysis

To analyze the effect of genotype, foliar fertilization treatments, and year, as well as their interactions on the expression of grain weight per spike, an analysis of variance (ANOVA) was conducted using the MSTAT-C program (Michigan State University, 1990). Multiple comparisons of the variants of the investigated factors were performed using the Least Significant Difference (LSD) test at two significance levels, 1% and 5%.

3. RESULTS AND DISCUSSION

The selection of suitable varieties and balanced fertilizer application are key agronomic practices for enhancing wheat productivity and quality (Panayotova et al., 2017). Therefore, it was important to conduct research on divergent durum wheat genotypes grown under various foliar nitrogen treatments and in different seasons. This study presents the impact of these factors and their interactions on grain weight per spike. Grain weight per spike is an essential yield component that, along with the number of spikes per square meter and the number of spikelets per spike, directly affects durum wheat yield (Kendal, 2019). Furthermore, grain weight per spike serves as a useful phenotypic marker for selecting suitable wheat genotypes, particularly under drought stress conditions (Xu et al., 2023).

The analysis of variance shows a highly significant ($p < 0.01$) effect of the main factors (genotype, year, and foliar nitrogen fertilization treatment) on the phenotypic expression of grain weight per spike (Table 1). The largest proportion of variation in this yield component was attributed to genotype (25.25%), followed by year (15.57%) and foliar nitrogen fertilization treatment (13.65%).

Table 1. Analysis of variance for grain weight per spike in different durum wheat genotypes under three foliar fertilization treatments grown in two vegetation seasons

Source of variation	df	Sum of Squares	Mean Square	F-value	p-value	% sum of squares[1]
Genotype (G)	6	1.948	0.325	15.688^{**}	0.000	25.25
Year (Y)	1	1.201	1.201	58.034^{**}	0.000	15.57
Treatment (T)	2	1.053	0.526	25.445^{**}	0.000	13.65
G × Y	6	1.314	0.219	10.582^{**}	0.000	17.03
G × T	12	0.171	0.014	0.688^{ns}	0.758	2.21
Y × T	2	0.069	0.035	1.674^{ns}	0.194	0.89
G × Y × T	12	0.221	0.018	0.892^{ns}	0.558	2.86
Error	84	1.738	0.021	–	–	–
Total	125	7.714	–	–	–	–

$^{**}p \leq 0.01$: statistically significant effect at the 1% significance level; ^{ns}Non-significant ($p>0.05$)
[1]The share of the sum of squares (%) of the analyzed factors and their interactions is expressed in relation to the sum of squares of the total (100%).

The largest contribution of the genotype factor indicates the presence of divergence in the studied genetic material. Additionally, Zečević et al. (2010), Knežević et al. (2008, 2015), and Kondić et al. (2017) have found that genotype and the external environment significantly affect the variability of grain weight per spike in wheat. The G × Y interaction was statistically significant ($p < 0.01$), while the G × T, T × Y, and G × Y × T interactions were not statistically significant ($p > 0.05$).

Table 2 presents the values of grain weight per spike for all genotypes under the analyzed treatments and seasons. A comparison of the genotypes, regardless of the treatments applied and the years, showed that the genotype KG-3405-03 had the highest average grain weight per spike (1.59 g) and was significantly different ($p < 0.05$) from the other genotypes, except from the KG-44-3/1 line (1.49 g). The lowest value of this trait in the trial was observed in the genotype KG Olimpik (1.22 g) which was significantly different from the other genotypes, except for Windur (1.23 g). An increase in grain weight per spike was observed under the fertilization treatments compared to the control (1.27 g), with values of 1.39 g for one foliar spray (T2) and 1.49 g for two foliar sprays (T3), with significant differences observed between the treatments. The application of the same foliar fertilization treatments had a positive effect on the number of spikes per square meter, number of grains per spike, 1000-grain weight, and grain yield for the same durum wheat genotypes (Zečević et al., 2022). Lopez-Bellido et al. (2012) and Pampana et al. (2013) highlight that split nitrogen fertilizer applications improve nitrogen use efficiency, but the crop response significantly depends on climate and agronomic practices, such as fertilizer quantity, type, splitting ratios, and application timing. Although durum wheat is known for its drought tolerance, it can be negatively affected by water stress (De Vita and Taranto, 2019). On average, for all genotypes and treatments, a significantly higher grain weight per spike was observed in the 2012/2013 season (1.49 g) compared to the 2013/2014 season (1.29 g), which was characterized by considerably lower amount of precipitation. Xu et al. (2023) found that grain weight per spike decreased by 31.7% in wheat under drought conditions. Saghouri el Idrissi et al. (2023) found that grain yield per plant in durum wheat genotypes decreases as water stress increases.

Table 2. Influence of interaction of genotype, treatment and season on the variation of grain weight per spike

Genotype	Foliar fertilization						Average
	T1		T2		T3		
	2013	2014	2013	2014	2013	2014	
Windur	1.19	1.05	1.23	1.13	1.57	1.18	1.22[d]
KG Olimpik	1.12	1.09	1.37	1.09	1.56	1.18	1.23[cd]
Žitka	1.36	1.12	1.64	1.16	1.68	1.20	1.36[bc]
KG-28-6	1.35	1.27	1.51	1.42	1.60	1.54	1.45[b]
KG-44-3/1	1.47	1.44	1.54	1.47	1.56	1.47	1.49[ab]
KG-43-33/1	1.09	1.29	1.38	1.40	1.42	1.61	1.37[b]
KG-3405-03	1.79	1.21	1.86	1.28	1.91	1.50	1.59[a]
Average	1.33	1.21	1.50	1.28	1.61	1.38	1.38
	1.27[C]		1.39[B]		1.49[A]		
LSD	G	Y	G × Y	T	G × T	Y × T	G × Y × T
0.05	0.135	-	0.191	0.088	NS	NS	NS
0.01	0.179	-	0.253	0.117	NS	NS	NS

Means followed by different lowercase letter(s) differ significantly between genotypes, while means followed by different uppercase letter(s) differ significantly between treatments at 5% level of significance: NS- nonsignificant.

The highest average value of grain weight per spike was recorded with the T3 treatment in 2012/2013 (1.61 g), while the lowest average value was found under the T1 treatment in 2013/2014 (1.21 g). In 2013, the grain weight per spike under the control treatment (T1) was lower than under the other treatments for that season (1.31 g). However, this value was higher compared to the T2 treatment (one foliar spray) in the less favorable 2013/2014 season (1.28 g), suggesting that the season plays a key role in the variation of grain weight per spike among the analyzed durum wheat genotypes. Considering only the 2014 season, the T3 treatment also resulted in the highest grain weight per spike (1.38 g) on average for all genotypes, compared to the other treatments in that season. Therefore, it can be concluded that the application of the T3 treatment improved grain weight per spike in both the favorable (2012/2013) and less favorable (2013/2014) growing seasons.

The highest value of grain weight per spike at the experimental level was observed for the genotype KG-3405-03 with the application of the T3 treatment in the 2013 season (1.91 g). In the 2013/2014 season, the highest grain weight per spike was observed in genotype KG-43-33/1 with the T3 treatment (1.61 g). This genotype has the lowest value in the 2012/2013 season under the control treatment (1.09 g). The lowest average grain weight per spike at the trial level was recorded for the genotype Windur (1.05 g), followed by the genotype KG Olimpik (1.09 g), under the treatment without foliar fertilization during the 2013/2014 season (Table 2).

The G × Y interaction was statistically significant ($p < 0.01$) and was therefore analyzed in detail and presented in Figure 2. This significance indicates that different genotypes exhibit varying responses to climatic conditions across the studied years. It suggests that the ranking of genotypes in terms of grain weight per spike changes from year to year.

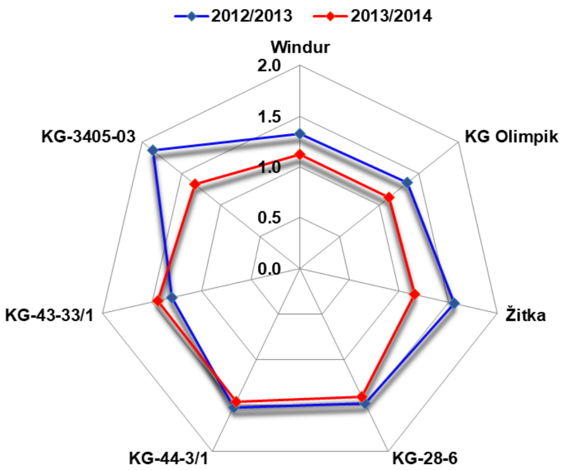

Figure 2. Grain weight per spike for durum wheat genotypes across the analysed seasons

The genotype KG-3405-03 shows high variation in grain weight per spike, with the highest value of 1.86 g in the 2012/2013 season, which decreases by 28.5% to 1.33 g in the 2013/2014 season, indicating its potential in favorable conditions and significant sensitivity to unfavorable environmental factors. In contrast, the genotypes KG-28-6 and KG-44-3/1 showed the least variation between years, making them suitable for cultivation in diverse agroecological conditions. The genotypes Windur and KG Olimpik demonstrated satisfactory stability, but they do not exhibit high potential for achieving elevated grain weight per spike in favorable conditions. The genotype Žitka showed high variation across vegetation seasons, with above-average grain weight per spike in favorable conditions and below-average grain weight in unfavorable conditions. The genotype KG-43-33/1 showed an opposite trend to the other genotypes, with a higher grain weight per spike in the less favorable 2013/2014 season (1.44 g) compared to the 2012/2013 season (1.30 g), which had more evenly distributed rainfall (Figure 2). This suggests that this genotype responds very well to the application of treatment T3 in the 2013/2014 season and may have advantages in specific ecosystems.

4. CONCLUSION

Both foliar fertilization treatments increased grain weight per spike in the analyzed durum wheat genotypes compared to the control (no treatment). The treatment with two foliar sprays (T3) proved to be the most effective in improving grain weight per spike, both under favorable and unfavorable environmental conditions. The genotype KG-3405-03 showed the best response to the T3 treatment in favorable conditions in 2013, with the highest average value of grain weight per spike (1.91 g). However, this genotype also showed the greatest reduction (28.5%) in the less favorable 2013/2014 season. On average, across all treatments, the genotype KG-43-33/1 achieved significantly higher values in the less favorable season compared to the favorable growing season, indicating its exceptional adaptability to adverse climatic conditions when foliar fertilization is applied. The reason for the higher values in the unfavorable season is that this genotype had the best response to the T3 treatment under unfavorable conditions, achieving the highest grain weight per spike (1.61 g). On the other hand, genotypes KG-28-6 and KG-44-3/1 demonstrated good stability, with above-average values on the treatment without nitrogen application (control) in both seasons, making them suitable for cultivation in diverse agroecological conditions.

5. ACKNOWLEDGMENT

This research is part of the project funded by the Ministry of Education, Science, and Technological Development of the Republic of Serbia, titled "Study of the Genetic Basis of Improving Yield and Quality of Small Grains in Different Environmental Conditions" (TR31092). Additionally, this research is financially supported by the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia, under grant numbers: 451-03-66/2024-03/200054 and 451-03-66/2024-03/200216.

6. REFERENCES

Bassu, S., Asseng, S., Motzo, R., Giunta, F. (2009). Optimising sowing date of durum wheat in a variable mediterranean environment. Field Crops Research, 111, 109-118. doi.org/10.1016/j.fcr.2008.11.002

Bozek, K.S., Zuk-Golaszewska, K., Bochenek, A., Golaszewski, J., Kalaji, H.M. (2021). Modelling the growth, development and yield of *Triticum durum* desf under the changes of climatic conditions in north-eastern Europe. Scientific Reports, 11, 21753. doi.org/10.1038/s41598-021-01273-8

Cséplő, M., Puskás, K., Vida, G., Ambrózy, Z., Grausgruber, H., Urbanavičiūtė, I., Mikó, P., Bányai, J. (2024). Performance of a durum wheat diversity panel under different management systems. Cereal Research Communications, doi.org/10.1007/s42976-024-00517-3

De Vita, P., Taranto, F. (2019). Durum wheat (*Triticum turgidum* ssp. *durum*) breeding to meet the challenge of climate change. Published in Advances in Plant Breeding Strategies: Cereals, Al-Khayri, J., Jain, S., Johnson, D. (Eds.), Cham, *Switzerland*: Springer. doi.org/10.1007/978-3-030-23108-8_13

Di Mola, I., Ottaiano, L., Sacco, A., Senatore, M., Mori, M. (2021). Organic versus mineral fertilization: Assessing of yield and quality of durum wheat in marginal lands. Italian Journal of Agronomy, 16, 1855. doi.org/10.4081/ija.2021.1855

Ercoli, L., Masoni, A., Pampana, S., Mariotti, M., Arduini, I. (2013). As durum wheat productivity is affected by nitrogen fertilisation management in Central Italy. European Journal of Agronomy, 44, 38-45. dx.doi.org/10.1016/j.eja.2012.08.005

Grosse-Heilmann, M., Cristiano, E., Deidda, R., Viola, F. (2024). Durum wheat productivity today and tomorrow: A review of influencing factors and climate change effects. Resources, Environment and Sustainability, 17, 100170. doi.org/10.1016/j.resenv.2024.100170

International Grains Council (IGC). Available online: https://www.igc.int/en/default.aspx (Accessed on 15 June 2023).

Kabbaj, H., Sall, A.T., Al-Abdallat, A., Geleta, M., Amri, A., Filali-Maltouf, A., Belkadi, B., Ortiz, R., Bassi, F.M. (2017). Genetic diversity within a global panel of durum wheat (*Triticum durum*) landraces and modern germplasm reveals the history of allele exchange. Frontiers in Plant Science, 8, 1277. doi.org/10.3389/fpls201701277

Kendal, E. (2019). Comparing durum wheat cultivars by genotype × yield × trait and genotype × trait biplot method. Chilean Journal of Agricultural Research, 79(4), 512-522. doi.org/10.4067/S0718-58392019000400512

Knežević, D., Zečević, V., Djukić, N., Dodig, D. (2008). Genetic and phenotypic variability of grain mass per spike of winter wheat genotypes (*Triticum aestivum* L.). Kragujevac Journal of Science, 30(1), 131-136.

Knezevic, D., Kondic, D., Markovic, S., Markovic, D., Atanasijevic, S. (2014). Genetic and phenotypic variability, of grain mass and length of spike in wheat (*Triticum aestivum* L.) effected by nitrogen nutrition. Növénytermelés, Supplement, 63, 47-50.

Knežević, D., Radosavac, A., Zelenika, M. (2015). Variability of grain weight per spike in wheat grown in different ecological conditions. Acta Agriculturae Serbica, 20(39), 85-95.

Kondić, D., Bajić, M., Hajder, Đ., Knežević, D., Bosančić, B. (2017). The spike characteristics of winter wheat (*Triticum aestivum* L.) varieties in agro-ecological conditions of Banja Luka region. Agro-knowledge Journal, 18(4) 263-274. doi.org/10.7251/AGREN1704263K

Lopez-Bellido, L., Munoz-Romero, V., Benítez-Vega, J., Fernández-García, P., Redondo, R., López-Bellido, R.J. (2012). Wheat response to nitrogen splitting applied to Vertisols in different tillage systems and cropping rotations under typical Mediterranean climatic conditions. European Journal of Agronomy, 43, 24-32. doi.org/10.1016/j.eja.2012.05.002

Mancinelli, R., Marinari, S., Atait, M., Petroselli, V., Chilosi, G., Jasarevic, M., Catalani, A., Abideen, Z., Mirzaei, M., Allam, M., Radicetti, E. (2023). Durum wheat potato crop rotation, soil tillage, and fertilization source affect soil CO_2 emission and C storage in the Mediterranean environment. Land, 12(2), 326. doi.org/10.3390/land12020326

Martínez-Moreno, F., Ammar, K., Solís, I. (2022). Global changes in cultivated area and breeding activities of durum wheat from 1800 to date: A historical review. Agronomy, 12(5), 1135. doi.org/10.3390/agronomy12051135

Michigan State University (1990). User's Guide to MSTAT-C. Michigan State University, Michigan.

Mie, A., Andersen, H.R., Gunnarsson, S., Kahl, J., Kesse-Guyot, E., Rembiałkowska, E., Quaglio, G., Grandjean, P. (2017). Human health implications of organic food and organic agriculture: a compre hensive review. Environment Health, 16, 111. doi.org/10.1186/s12940-017-0315-4

Morari, F., Zanella, V., Sartori, L., Visioli, G., Berzaghi, P., Mosca, G. (2017). Optimising durum wheat cultivation in north Italy: understanding the effects of site-specific fertilization on yield and protein content. Precision Agriculture, 19, 257-277. doi.org/10.1007/s11119-017-9515-8

Pampana, S., Masoni, A., Ercoli, L., Mariotti, M., Arduini, I. (2013). Effects of nitrogen splitting and source on durum wheat. Cereal Research Communications, 41, 338-347. doi.org/10.1556/CRC.2013.0003

Panayotova, G., Kostadinova, S., Valkova, N. (2017). Grain quality of durum wheat as affected by phosphorus and combined nitrogen phosphorus fertilization. Scientific Papers Series A. Agronomy, 60, 356-363.

Pour-Aboughadareh, A., Mohammadi, R., Etminan, A., Shooshtari, L., Maleki Tabrizi, N., Poczai, P. (2020). Effects of drought stress on some agronomic and morpho-physiological traits in durum wheat genotypes. Sustainability, 12(14), 5610. doi.org/10.3390/su12145610

Saghouri el idissi, I., Kettani, R., Ferrahi, M., Nabloussi, A., Ziri, R., Brhadda, N. (2023). Water stress effect on durum wheat (*Triticum durum Desf.*) advanced lines at flowering stage under controlled conditions. Journal of Agriculture and Food Research, 14, 100696. doi.org/10.1016/j.jafr.2023.100696

Sieber, A.-N., Würschum, T., Longin, C.F.H., Tuberosa, R. (2014). Evaluation of a semi-controlled test as a selection tool for frost tolerance in durum wheat (*Triticum durum*). Plant Breeding, 133, 465–469. doi.org/10.1111/pbr.12181

Vida, G., Cséplő, M., Rakszegi, M., Bányai, J. (2022). Effect of multi-year environmental and meteorological factors on the quality traits of winter durum wheat. Plants, 11, 113. doi.org/10.3390/plants11010113

Wang, X., Pacho, F., Liu, J., Kajungiro, R. (2019). Factors influencing organic food purchase intention in developing countries and the moderating role of knowledge. Sustainability, 11(1), 209. doi.org/10.3390/su11010209

Xu, Z., Lai, X., Ren, Y., Yang, H., Wang, H., Wang, C., Xia, J., Wang, Z., Yang, Z., Geng, H., Shi, X., Zhang, Y. (2023). Impact of drought stress on yield-related agronomic traits of different genotypes in spring wheat. Agronomy, 13(12), 2968. doi.org/10.3390/agronomy13122968

Zečević, V., Bošković, J., Dimitrijević, M., Petrović, S. (2010). Genetic and phenotypic variability of yield components in wheat (*Triticum aestivum* L.). Bulgarian Journal of Agricultural Science, 16 (4), 422–428.

Zečević, V., Milenković, S., Bošković, J., Roljević Nikolić, S., Luković, K., Đorđević, R., Kneđević, D. (2022). Influence of foliar nutrition on yield and yield components of durum wheat (*Triticum durum* Desf.) grown in system of organic production. Applied Ecology and Environmental Research, 20(1), 171-187. dx.doi.org/10.15666/aeer/2001_171187