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Research Article

Evaluation of Some Bread Wheat (*Triticum aestivum* L.) Cultivars and Lines for Yield and Yield Components under Duzce Ecological Conditions

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ABSTRACT

Wheat is an important cereal crop in terms of cultivation area and production in Turkey and around the world. Due to climate change, increasing world population, decreasing agricultural lands and waters, the demand for wheat and wheat-based products has increased in Turkey. The study was carried out to determine yield and yield components of some bread wheat genotypes under Duzce ecological conditions in 2020-2021 and 2021-2022 growing seasons. In this research, spike length, spikelet number per spike, grain number per spike, grain weight per spike, thousand kernel weight and grain yield were investigated. According to the two year results, spike length 8.3-11.9 cm, number of spikelets per spike 16.5-19.9, number of grains per spike 44.8-57.8, grain weight per spike 1.68-2.50 g, thousand kernel weight 40.8-51.2 g and grain yield ranged between 4611-7875 kg ha-1. The highest yielding genotypes were found as H8G3, H8G5, H9G4, Rumeli and Lucilla.

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INTRODUCTION

More than 20% of the world's protein and calorie requirements are supply by wheat (Braun et al. 2010). However, food supply may become increasingly challenging in the future due to population growth, the reduction of fertile land and water resources available for agriculture, the use of agricultural products for biofuels, and the effects of climate change (Parry and Hawkesford 2010; Lobell et al. 2011; Hawkesford et al. 2013).

Wheat is the second most important product in the world after corn, and is the most common grain in Turkey. Despite a decrease of 27% in wheat cultivation area in Turkey over the past 20 years (TUIK 2023), wheat production has been maintained through the development of cultivation techniques and breeding programs. Recent developments in the seed industry and the introduction of new cultivars play an important role in increasing yields.

To achieve high yield and quality wheat genotypes, suitable growing conditions and techniques, as well as the selection of cultivars with optimal yield potential, are necessary (Altinbas et al. 2004; Aydogan and Soylu 2017; Sakin et al. 2022). Therefore, researchers have conducted numerous studies to develop and evaluate new cultivars under different ecological conditions, focusing on yield, yield components, and quality characteristics (Kahraman et al. 2021; Gungor et al. 2022a; Naneli 2022)

The successful increase in grain yield has been demonstrated through studies based on selection criteria such as grain number and weight per spike (Kurt Polat et al. 2015). Ullah et al. (2021) have found that there are significant positive relationships between grain yield and the length of the spike, the number of spikelets, the number of grains per spike, and thousand kernel weight.

This study was aimed at identifying suitable genotypes by examining the yield and yield components of 12 advanced bread wheat lines developed through breeding programs and four registered cultivars under Duzce ecological conditions.

MATERIAL AND METHODS

The study was carried out in Duzce province in rainfed conditions during the 2020-2021 and 2021-2022 cropping seasons. Four registered bread wheat cultivars (Esperia, Glosa, Lucilla and Rumeli) and 12 advanced bread wheat lines (H0G6, H1G0, H2G5, H3G6, H6G6, H6G7, H6G8, H7G4, H8G3, H8G5, H9G4 and H9G7) were used in the study.

The soil structure of the experimental area was clayey and slightly acidic. The organic matter and nitrogen content were high, while the phosphorus and potassium content were low. There was no salinity problem (Table 1). The climate data for the two year growing seasons and long years in the experimental area are given in Table 2.

Table 1. *Soil structure of the experiment area*

Soil Structure	Clayey
Organic matter (%)	4.874
pH	6.41
Nitrogen (%)	0.244
Phosphorus (ppm)	0.57
Potassium (ppm)	26
Salt (%)	0.033

Table 2. *Mean climatic data belonging to trial years*

Months	2020-2021		2021-2022		Long Years	
	Temperature (°C)	Precipitation (mm)	Temperature (°C)	Precipitation (mm)	Temperature (°C)	Precipitation (mm)
November	8.8	22.2	11.6	61.2	9.4	76.5
December	9.7	27.0	9.6	72.5	5.7	100.9
January	7.0	129.4	3.6	176.0	3.7	91.3
February	7.3	36.0	6.7	111.0	5.2	70.4
March	6.8	97.8	5.8	96.3	7.6	73.9
April	12.5	100.0	14.0	46.4	12.2	59.3
May	18.3	92.8	17.4	20.0	16.5	62.8
June	20.5	99.4	21.5	204.2	20.3	70.5
July	24.6	143.2	22.7	23.8	22.4	45.1
Total		747.8		811.4		650.7

The research was conducted as a randomized block design with three replications. Both cropping seasons were sown manually in the first week of November, with 500 seeds per square meter and a row spacing of 20 cm with 5 m long and 6 rows wide. The plot sizes were 6 m2 for both the planting and harvesting areas. Herbicide was used for weed control in the trial plots. There was no chemical use for the pests. Fifty kg ha-1 of nitrogen and 50 kg ha-1 of phosphorus were applied per hectare with sowing, and the top dressing was split into two with 90 kg ha-1 of nitrogen applied during tillering and 60 kg ha-1 of nitrogen applied during the jointing stage. In both growing seasons, the harvest was completed in the first week of July. Ten spikes were randomly selected from each plot to determine spike length, spike number, grain number per spike, and grain weight per spike. Grain yield was determined by harvesting the plots. The thousand kernel weight was defined as counting 100 seeds four times and weighed on a 0.001 precision scale, then averaged and multiplied by 10. Data obtained from the research over two years were analyzed using JMP 10 statistical analysis program (JMP 2010), and Duncan test was applied to compare the means.

RESULTS

According to the combined analysis of variance, genotype, year and genotype × year interactions were found to be significant for all investigated traits (Table 3).

Table 3. *Mean square values for the investigated traits*

Sources of variations	DF	GY	TKW	SL	SNS	GNS	GWS
Replication	2	2586 ns	2.9 ns	0.26 ns	0.74 ns	20 ns	0.002 ns
Year	1	123833**	339**	47**	12**	1834**	27**
Genotype	15	71339**	54**	5,8**	4.97**	1834**	0.27**
Genotype ×Year	15	10803**	27**	0.68**	2.28**	53**	0.13*
Error	62	4572.2	1.02	0.13	0.64	20.49	0.08
CV		10.83	2.19	3.79	4.35	9.04	13.25

** significant at P<0.01, * significant at P<0.05, ns: not significant, CV (%): Variation of coefficient, DF: Degrees of freedom, GY: Grain yield, SL: Spike length, SNS: Number of spikelets per spike, GNS: Number of grains per spike, GWS: Grain weight per spike, TKW: Thousand kernel weight

The average values for spike length and spikelet number per spike are given in Table 4. The spike length of bread wheat genotypes varied between 9.0-12.8 cm in the first year, 7.6-11.0 cm in the second year, and 8.3-11.9 cm on average over the two years. The maximum spike length was observed in genotype H2G5 (11.9 cm) and the minimum was observed in the Esperia cultivar (8.3 cm). The mean spike length was determined as 10.3 cm in the first year, 8.9 cm in the second year, and 9.6 cm on average over the two years (Table 4).

Spike length is a genotype specific trait that is also significantly affected by environmental factors (Bilgin and Korkut 2005; Kaydan and Yagmur 2008). Ozkan (2022) and Mahpara et al. (2017) have reported that increasing spike length contributes to an increase in grain yield. The results obtained regarding spike length in this study were in line with previous findings from Aydogan and Soylu (2017) (8.87-11.10 cm), Gungor and Dumlupinar (2019) (7.3-10.0 cm), Albayrak et al. (2022) (6.47-9.08 cm), Bozkurt et al. (2022) (7.13-9.10 cm), and Gungor et al. (2022b) (7.4-10.4 cm).

Table 4. *Mean values of spike length (cm) and spikelets/spike (no)*

Genotypes	Spike Length (cm)			Spikelets/Spike (no)		
	2020-21	2021-22	Mean	2020-21	2021-22	Mean
H0G6	10.0 de	8.1 ef	9.0 f-h	19.4 bcd	18.2 b-d	18.8 cd
H1G0	12.3 a	11.0 a	11.6 a	19.7 bc	20.2 a	19.9 a
H2G5	12.8 a	10.9 a	11.9 a	18.0 efg	18.2 b-d	18.1 c-e
H3G6	10.6 b-d	9.1 bc	9.8 b-d	18.3 d-g	18.4 b-d	18.4 c-e
H6G6	11.1 b	8.9 cd	10.0 b	21.1 a	18.5 bc	19.8 ab
H6G7	10.3 cd	8.8 cd	9.6 c-e	18.7 c-f	16.7 ef	17.7 ef
H6G8	9.7 ef	9.4 bc	9.6 c-e	18.9 b-e	19.1 ab	19.0 a-c
H7G4	9.6 ef	7.6 f	8.6 ıj	17.4 f-h	15.5 f	16.5 g
H8G3	10.8 bc	9.0 bc	9.9 bc	20.0 ab	17.4 c-e	18.7 cd
H8G5	10.1 de	9.6 b	9.8 b-d	17.1 gh	18.0 b-e	17.5 ef
H9G4	9.6 ef	7.6 f	8.6 h-j	18.9 b-e	17.0 de	17.9 d-f
H9G7	9.7 ef	9.2 bc	9.4 d-f	18.9 b-e	19.1 ab	18.9 bc
Esperia	9.0 g	7.6 f	8.3 j	16.8 h	17.5 c-e	17.1 fg
Glosa	10.0 de	7.8 ef	8.9 g-ı	18.2 d-g	17.3 c-e	17.7 ef
Lucilla	9.4 fg	9.1 bc	9.3 e-g	18.2 d-g	18.5 bc	18.4 c-e
Rumeli	9.5 e-g	8.3 de	8.9 g-ı	19.1 b-e	17.5 c-e	18.3 c-e
Mean	10.3 a	8.9 b	9.6	18.7 a	17.9 b	18.3

Differences between the means followed by the same letter are not significant at P<0.05 level

The number of spikelets per spike of bread wheat genotypes varied between 16.8 to 21.1 pieces/spike in the first year and from 15.5 to 20.2 pieces/spike in the second year, according to Table 4. The number of spikelets per spike varied between 16.5 and 19.9 pieces/spike according to the combined year values. The highest number of spikelets per spike was recorded in genotype H1G0 (19.9 pieces/spike) while the lowest spikelets per spike was recorded in genotype H7G4 (16.5 pieces/spike). The number of spikelets per spike positively affects the number of grains per spike and therefore, the yield per spike (Kahriman and Egesel 2011; Ozen and Akman 2015). Aydogan and Soylu (2017), Gungor and Dumlupinar (2019), Albayrak et al. (2022), and Gungor et al. (2022b) have reported that the number of spikelets per spike varied between 17.67 to 25.20 pieces/spike, 16.2 to 20.7 pieces/spike, 15.20 to 18.67 pieces/spike, and 16.4 to 20.3 pieces/spike, respectively.

The mean values of the number of grains per spike and grain weight per spike of bread wheat genotypes included in the study are given in Table 5. In the first year of the study, the number of grains per spike was determined to be 54.4 pieces/spike, while in the second year it was 45.7. The number of grains per spike varied among genotypes, ranging from 48.3 to 62.7 pieces/spike in the first year, 39.2 to 58.6 pieces/spike in the second year, and 44.8 to 57.8 pieces/spike when considering both years combined. The lowest number of grains per spike was found in the H6G7 genotype (44.8 pieces/spike) according to the combined years, while the highest was obtained in the H8G5 genotype (57.8) (Table 5). The number of grains per spike can vary depending on several factors, including sowing density (Dinc and Erekul 2010), irrigation conditions (Subasi and Ayranci 2021), sowing methods (Kaydan et al. 2011), genetic structure (Bayram et al. 2017; Gungor and Dumlupinar 2019), and the spike's potential length and spikelet frequency, as reported by Ubaidullah et al. (2006). The number of grains per spike ranged from 27.2 to 49.7 pieces/spike in the study conducted by Gungor and Dumlupinar (2019), from 27.00 to 53.40 pieces/spike in the study conducted by Albayrak et al. (2022), and from 34.2 to 59.6 pieces/spike in the study conducted by Gungor et al. (2022b).

The grain weight per spike of the bread wheat genotypes included in the experiment was determined as 2.62 g in the first year, 1.55 g in the second year, and 2.09 g for the combined years. The lowest grain weight per spike, as observed in Table 5, was obtained from the Esperia cultivar with 1.68 g, while the Lucilla cultivar yielded the highest grain weight per spike with 2.50 g. (Table 5).

Table 5. *Mean values of grains/spike (number) and grain weight/spike (g)*

Genotypes	Grains/Spike (number)			Grain Weight/Spike (g)		
	2020-21	**2021-22**	**Mean**	**2020-21**	**2021-22**	**Mean**
HOG6	50.5 c-e	44.2 cd	47.4 de	2.43 c-e	1.50 b-d	1.96 d-f
H1G0	55.7 b-d	46.7 b-d	51.2 cd	2.98 a-c	1.50 b-d	2.40 a-d
H2G5	48.3 e	43.3 cd	45.8 e	2.58 b-e	1.52 b-d	2.05 c-e
H3G6	52.3 c-e	46.3 b-d	49.3 de	2.56 b-e	1.48 b-d	2.02 de
H6G6	61.0 ab	42.7 cd	51.9 b-d	2.76 b-d	1.49 b-d	2.13 c-e
H6G7	50.4 c-e	39.2 d	44.8 e	2.37 de	1.50 b-d	1.93 d-f
H6G8	59.3 ab	53.9 ab	56.6 ab	2.45 c-e	1.66 bc	2.05 c-e
H7G4	60.9 ab	43.5 cd	52.2 b-d	2.38 de	1.30 d	1.84 ef
H8G3	62.7 a	46.6 b-d	54.6 a-c	3.12 ab	1.77 ab	2.44 ab
H8G5	56.9 a-c	58.6 a	57.8 a	2.66 b-e	2.07 a	2.36 a-c
H9G4	61.1 ab	43.3 cd	52.2 b-d	2.59 b-e	1.42 cd	2.01 de
H9G7	48.7 e	46.2 b-d	47.5 de	2.33 de	1.73 bc	2.03 de
Esperia	48.7 e	42.0 cd	45.4 e	2.16 e	1.48 b-d	1.68 f
Glosa	52.5 c-e	43.1 cd	47.8 de	2.78 a-d	1.20 d	2.13 b-e
Lucilla	52.5 c-e	49.7 bc	51.1 cd	3.35 a	1.66 bc	2.50 a
Rumeli	49.2 de	41.4 cd	45.3 e	2.48 c-e	1.53 b-d	2.01 de
Mean	54.4 a	45.7 b	50.1	2.62 a	1.55 b	2.09

Differences between the means followed by the same letter are not significant at P<0.05 level

Grain weight per spike is a trait directly related to the photosynthetic capacity of plants and varies depending on genotype, climate, and cultivation techniques applied (Balkan and Genctan 2008). In studies conducted under different ecological conditions, researchers have reported that the grain weight per spike varied between 0.93-2.25 g (Gungor and Dumlupinar 2019), 1.61-3.33 g (Aydogan and Yagdi 2021), 1.11-1.82 g (Albayrak et al. 2022), and 0.81-1.80 g (Ozkan 2022).

The mean values of the thousand kernel weight and grain yield are given in Table 6. In the study, thousand kernel weight varied between 39.7-56.9 g in the first year, 39.2-48.4 g in the second year, and between 40.8-51.2 g on average across the years. The lowest thousand kernel weight based on the average of the years was determined in the H6G8 (40.8 g) genotype, while the highest thousand kernel weight was obtained from the H2G5 (51.2 g) genotype (Table 6).

Table 6. *Mean values of thousand kernel weight (g) and grain yield (kg ha^{-1})*

Genotypes	Thousand Kernel Weight (g)			Grain Yield (kg ha^{-1})		
	2020-21	**2021-22**	**Mean**	**2020-21**	**2021-22**	**Mean**
HOG6	46.3 e-g	44.9 b-d	45.6 g	5426 e-g	7338 a	6382 cd
H1G0	53.4 b	42.9 ef	48.2 c-e	5261 fg	4392 e	4826 fg
H2G5	56.9 a	45.5 bc	51.2 a	5885 d-f	4243 e	5063 fg
H3G6	49.7 cd	43.1 ef	46.4 fg	5941 de	4943 de	5442 ef
H6G6	45.8 fg	45.4 bc	45.5 g	5273 fg	4476 e	4875 fg
H6G7	46.2 e-g	48.1 a	47.1 ef	6046 c-e	5085 de	5565 ef
H6G8	39.7 h	42.0 fg	40.8 ı	4816 g	4416 e	4611 g
H7G4	41.3 h	41.0 g	41.2 ı	6100 cd	6175 a-d	6138 de
H8G3	50.4 c	48.4 a	49.4 b	7923 ab	7067 a	7495 ab
H8G5	46.8 ef	43.9 de	45.3 g	8315 a	7435 a	7875 a
H9G4	45.0 fg	43.0 ef	44.0 h	7558 b	6894 ab	7226 ab
H9G7	48.1 de	47.7 a	47.9 de	7473 b	6605 a-c	7039 bc
Esperia	44.7 e	39.2 h	41.9 ı	6681 c	5338 c-e	6009 de
Glosa	53.8 b	44.5 cd	49.2 bc	7418 b	5434 b-e	6426 cd
Lucilla	49.9 cd	43.1 ef	46.5 fg	7510 b	7054 a	7282 ab
Rumeli	51.1 c	46.2 b	48.7 b-d	7967 ab	7207 a	7587 a
Mean	48.1 a	44.3 b	46.2	6599 a	5881 b	6240

Differences between the means followed by the same letter are not significant at P<0.05 level

Thousand kernel weight varies according to genetic structure, the number of spikes per square meter, the number of grains per spike, climate and soil conditions, spike-ripening time, the number of main stems and tillers, and cultural practices (Sahin et al. 2004; Rahman et al. 2009; Abbas and Topal 2017). Thousand kernel weight has a significant impact on grain yield and is a quality criterion valued by industry due to its importance in estimating amount of flour (Mut et al. 2007; Kahriman and Egesel 2011; Sahin et al. 2013). Thousand kernel weight ranges documented in similar studies were as follows: Gungor et al. (2019) reported 35.8-47.2 g, Kahraman et al. (2021) found 35.3-46.5 g, Albayrak et al. (2022) observed 30.02-42.88 g, and Gungor et al. (2022b) identified 36.6-45.3 g.

The grain yields of the bread wheat genotypes varied between 4816-8315 kg ha^{-1} in the first year, 4243-7435 kg ha^{-1} in the second year, and 4611-7875 kg ha^{-1} in combined years, with an average grain yield of 6240 kg ha^{-1} (Table 6). The genotypes H8G5 (7875 kg ha^{-1}), Rumeli (7587 kg ha^{-1}), Lucilla (7282 kg ha^{-1}), and H9G4 (7226 kg ha^{-1}) had the highest grain yields according to the combined year averages, while the genotypes H6G8 (4611 kg ha^{-1}), H1G0 (4826 kg ha^{-1}), and H6G6 (4875 kg ha^{-1}) had the lowest grain yields (Table 6). In similar studies, grain yields ranging from 5152-7907 kg ha^{-1} were reported by Gungor and Dumlupinar (2019), 5985-7083 kg ha^{-1} by Kahraman et al. (2021), 1345-3463 kg ha^{-1} by Albayrak et al. (2022), and 2940-6562 kg ha^{-1} by Aydogan and Yagdi (2021). Grain yield varies according to environmental factors, genetic potential, and cultural practices (Aydogan and Soylu 2017; Gungor and Dumlupinar 2019; Atak et al. 2021; Gungor et al. 2022b).

CONCLUSION

In recent years, wheat breeding studies have rapidly increased, and developed cultivars and candidates have been tested under different ecological conditions to determine their grain yield and quality traits. This research was carried out to determine the yield and yield components of 12 advanced bread wheat lines and four registered cultivars under Duzce ecological conditions. In terms of grain yield, the genotypes H8G3, H8G5, H9G4 Rumeli, and Lucilla stood out. It was determined that Glosa, H0G6, H3G5, H9G4, and H9G7 genotypes had higher yields than the average grain yield determined in the study.

Conflict of interest

The authors declared no conflict of interest.

Author contribution

All authors contributed equally.

Ethical Statement

During the writing process of the study titled "**Evaluation of Some Bread Wheat (*Triticum aestivum* L.) Cultivars and Lines for Yield and Yield Components under Duzce Ecological Conditions**", scientific rules, ethical and citation rules were followed; No falsification has been made on the collected data and this study has not been sent to any other academic media for evaluation. Ethics committee approval is not required.

REFERENCES

Abbas, B., & Topal, A. (2016). Evaluation of yield and yield components of bread wheat genotypes obtained from different sources.

Albayrak, Ö., Bayhan, M., Özkan, R., & Akıncı, C. (2022). Ekmeklik Buğday İleri Hatlarının Verim ve Verim Kriterlerinin İncelenmesi. *Dicle Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *11*(1), 173-182.

Altinbas, M., Tosun, M., Yuce, S., & Can, A. R. (2004). Effects of genotype and location on the grain yield and some quality traits in bread wheats (T. aestivum L.). *The Journal of Agricultural Faculty of Ege University (Turkey)*.

Mehmet, A. T. A. K., Özlem, K. I. S. A., & İbrahim, A. T. I. Ş. (2021). Ekim sıklığının buğday (Triticum sp.) genotiplerinin verim ve bazı kalite özelliklerine etkisi. *Mustafa Kemal Üniversitesi Tarım Bilimleri Dergisi*, *26*(2), 387-398.

Aydoğan, S., & Soylu, S. (2017). Determination of yield, yield components and some quality properties of bread wheat varieties. *Jornal of Central Research Institute for Field Crops*, *26*(1).

Aydoğan, R., & Yağdı, K. (2022). Bursa ekolojik koşullarında bazı ekmeklik buğday (triticum aestivum l.) çeşitlerinin tarımsal özelliklerinin değerlendirilmesi.

Balkan, A., & Genctan, T. (2008). Effects of different row spacing and seeding rate on grain yield and yield components in some bread wheat cultivars (Triticum aestivum L.). *Journal of Agricultural Sciences (Turkey)*.

Bayram, S., Öztürk, A., & Aydın, M. (2017). Ekmeklik buğday genotiplerinin Erzurum koşullarında tane verimi ve verim unsurları yönünden değerlendirilmesi. *Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi*, *27*(4), 569-579.

Bilgin, O., & Korkut, K. Z. (2005). Determination of some phynological traits and grain yield of bread wheat (Triticum aestivum L.) varieties and lines. *Journal of Tekirdag Agricultural Faculty*.

Bozkurt M, Olgun M, Bolat N (2022). Investigation of yield and quality characteristics of some bread wheat lines and varieties under Eskişehir irrigated conditions. Research Journal of Biology Sciences. 15(2): 74-79

Braun, H. J., Atlin, G., & Payne, T. (2010). Multi-location testing as a tool to identify plant response to global climate change. In *Climate change and crop production* (pp. 115-138). Wallingford UK: CABI.

Dınç, S., & Erekul, O. (2010). BAZI EKMEKLİK BUĞDAYLARDA (Triticum (testimm L.) EKİM SIKLIĞININ VERİM VE VERİM ÖĞELERİNE ETKİSİ. *Journal of Adnan Menderes University, Agricultural Faculty*, *7*(2).

Güngör, H., & Dumlupınar, Z. (2019). Evaluation of some bread wheat (Triticum aestivum L.) cultivars for yield, yield components and quality traits in Bolu conditions. *Turkish Journal of Agricultural and Natural Sciences*, *6*(1), 44-51.

Güngör, H., Çakır, M. F., & Dumlupınar, Z. (2022). İleri ekmeklik buğday (Triticum aestivum L.) hatlarının verim, verim unsuru ve kalite özellikleri bakımından değerlendirilmesi. *Avrupa Bilim ve Teknoloji Dergisi*, (35), 123-127.

Güngör, H., Cakir, M. F., & Dumlupinar, Z. (2022). Evaluation of wheat genotypes: genotype× environment interaction and gge biplot analysis. *Turkish Journal of Field Crops*, *27*(1), 149-157.

Hawkesford, M. J., Araus, J. L., Park, R., Calderini, D., Miralles, D., Shen, T., ... & Parry, M. A. (2013). Prospects of doubling global wheat yields. *Food and Energy Security*, *2*(1), 34-48.

JMP (2010). JMP User Guide, Release 10 Copyright © 2010, SAS Institute Inc., Cary, NC, USA, ISBN 978-1-59994-408-1.

Kahraman, T., Güngör, H., Öztürk, İ., İlker, Y., & Dumlupınar, Z. (2021). Ekmeklik buğday (Triticum aestivum L.) genotiplerinde genotip ve çevrenin tane verimi ve bazı kalite özellikleri üzerine etkisinin temel bileşen ve GGE biplot analizleri ile değerlendirilmesi. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi*, *24*(5), 992-1002.

Kahrıman, F., & Egesel, C. Ö. (2011). Farklı Ekmeklik Buğday Çeşitlerinin Agronomik Ve Kalite Özellikleri Bakımından Değerlendirilmesi. *Ordu Üniversitesi Bilim ve Teknoloji Dergisi*, *1*(1), 22-35.

Kaydan, D., & Yagmur, M. (2008). A research on yield and yield components of some bread wheat (Triticum aestivum L.) varieties in Van ecological conditions. *JOURNAL OF AGRICULTURAL SCIENCES-TARIM BILIMLERI DERGISI*, *14*(4).

Kaydan, D., Tepe, I., Yagmur, M., & Yergin, R. (2011). Effects of sowing methods and rates on weeds, grain yield and some yield components of wheat.

Polat, P. Ö. K., Çİfcİ, E. A., & Yağdı, K. (2015). Determination of relationships between grain yield and some yield components in bread wheat (Triticum aestivum L.). *Tarim Bilimleri Dergisi*, *21*(3), 355-362.

Lobell, D. B., Schlenker, W., & Costa-Roberts, J. (2011). Climate trends and global crop production since 1980. *Science*, *333*(6042), 616-620.

Mahpara, S., Ali, Z., Rehmani, M. I. A., Iqbal, J., & Shafiq, M. R. (2017). Studies of genetic and combining ability analysis for some physio-morphological traits in spring wheat using 7× 7 diallel crosses. *Int J Agric Appl Sci*, *9*(1), 33-40.

Aydın, N., Bayramoğlu, O. H., Özcan, H., & Mut, Z. (2007). Investigation of yield and primary quality characteristics of some bread wheat (Triticum aestivum L.) genotypes. *Anadolu Journal of Agricultural Sciences (Turkey)*.

Naneli, İ. (2022). Farklı Lokasyonlarda Bazı Ekmeklik Buğday Genotiplerinin Verim ve Kalitesinin Belirlenmesi. *ICONTECH INTERNATIONAL JOURNAL*, *6*(3), 47-58.

Özen, S., & Akman, Z. (2015). Determination of yield and quality characteristics of some bread wheat cultivars in Yozgat ecological conditions. *Ziraat Fakültesi Dergisi-Süleyman Demirel Üniversitesi*, *10*(1), 35-43.

Özkan, R. (2022). Diyarbakır'da yağışa dayalı koşullarda yetiştirilen ileri kademe ekmeklik buğday hatlarının değerlendirilmesi. *ISPEC Journal of Agricultural Sciences*, *6*(3), 583-590.

Parry, M. A., & Hawkesford, M. J. (2010). Genetic approaches to reduce greenhouse gas emissions: increasing carbon capture and decreasing environmental impact. In *Climate change and crop production* (pp. 139-150). Wallingford UK: CABI.

Rahman, M. M., Hossain, A. K. B. A. R., Hakim, M. A., Kabir, M. R., & Shah, M. M. R. (2009). Performance of wheat genotypes under optimum and late sowing condition. *Int. J. Sustain. Crop Prod*, *4*(6), 34-39.

Sahin, M., Gocmen, A., Aydogan, S. (2004). Quality criterions for wheat and barley breeding programs (A review). *Journal of Crop Research*. 1(1), 54-60

Şahİn, M., Akçacık, A. G., Aydoğan, S., & Özer, E. (2013). Effect of grain size on quality traits in bread wheat. *Anadolu*, *23*(2), 1-8.

Sakin, M. A., Akbalık, Ş., & Dirik, K. Ö. (2022). Çorum-İskilip Şartlarında Bazı Ekmeklik Buğday (Triticum aestivum L.) Çeşitlerinin Bazı Verim ve Kalite Özelliklerinin Belirlenmesi. *Gaziosmanpaşa Bilimsel Araştırma Dergisi*, *11*(2), 83-97.

Subasi, K., & Ayranci, R. (2021). Determination of the correlations between grain yields and agricultural characteristics of some bread wheat genotypes in Konya ecological conditions.

TUIK (2023). Turkish Statistical Institute. https://www.tuik.gov.tr (Accesed on 02.01.2023).

Ubaidullah, R., Mohammad, T., Hafeezullah, A. S., & Nassimi, A. W. (2006). Screening of wheat (Triticum aestivum L.) genotypes for some important traits against natural terminal heat stress. *Pak. J. Biol. Sci*, *9*, 2069-2075.

Ullah, M. I., Mahpara, S., Bibi, R., Shah, R. U., Ullah, R., Abbas, S., ... & Khan, M. I. (2021). Grain yield and correlated traits of bread wheat lines: Implications for yield improvement. *Saudi Journal of Biological Sciences*, *28*(10), 5714-5719.