RESEARCH ARTICLE

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Evaluation of some Triticale (x *Triticosecale* Wittmack) cultivars and lines under Duzce ecological conditions

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Abstract

This study was carried out with five triticale cultivars (Özer, Truva, Karma-2000, Alperbey and Tatlıcak-97) and 10 advanced triticale lines to determine the grain yield and yield components during 2020-2021 and 2021-2022 growing seasons under Duzce ecological conditions. In this study, the parameters of the genotypes such as spike length, number of spikelets per spike, number of grains per spike, grain weight per spike, thousand kernel weight, and grain yield were investigated. According to the two year results, whereas spike length, number of spikelets per spike, and number of grains per spike of genotypes changed 10.6-15.3 cm, 24.5-39.7, and 48.8-87.8, respectively, the grain related parameters such as grain weight per spike, thousand kernel weight, and grain yield were 2.518-4.261 g, 34.3-46.8 g, 720.2-1093.4 kg da^{-1}, respectively. The highest yielding genotypes were found to be T-5, T-8, T-9 and Özer.

Keywords: Triticale, Grain yield, Yield components

INTRODUCTION

Triticale (x *Triticosecale* Wittmack) is a self-pollinated allohexaploid species of cereals with AABBRR genome, which was derived from crossing *T. turgidum* and *Secale cereale* and mostly produced for its grain (Lukaszewski and Gustafson, 1987).

In Turkey, the triticale cultivation area was 93,990 ha, the production amount was 228,000 tons, and the average yield was 245 kg da^{-1} in 2021 (TUIK, 2022).

In terms of potential yield, triticale is similar to wheat, which is highly adaptable like rye. Triticale has high grain, green grass yield, rapid development, and growth characteristics. Additionally, its high lysine content is essential for both human and animal nutrition (Oral and Ulker, 2016).

Triticale (x *Triticosecale* Wittmack) is more suited for cultivation in marginal lands because it is more resistant to biotic and abiotic stress conditions than wheat (Villegas et al., 2010). The triticale has an essential place in eliminating the current roughage and concentrated feed deficit problem in Turkey (Mut and Erbas Kose, 2018).

It is crucial to expand triticale production and develop triticale varieties suitable for different regions to evaluate marginal areas and contribute to animal husbandry in Turkey (Senturk and Akgun, 2014).

This study was carried out to evaluate some triticale cultivars and advanced

lines in terms of yield and yield components in Duzce ecological conditions.

MATERIALS AND METHODS

The study was conducted in Duzce during the 2020–2021 and 2021–2022 growing seasons. 10 advanced triticale lines named as T-1, T-2, T-3, T-4, T-5, T-6, T-7, T-8, T-9, and T-10 as well as five registered triticale cultivars of Özer, Truva, Karma-2000, Alperbey, and Tatlcak-97 were both used in the study. The study was conducted in four replications using the randomized blocks experimental design. In both growing seasons, sowing was carried out manually in 5 m-long plots with 20 cm row spacing and six rows of 500 seeds per m^2 in the first week of November. At both planting and harvest, the experiment's parcel sizes were carried out to be 6 m^2. Herbicides were used for weed control in the trial plots, and no pesticides was applied for diseases and pests. After sowing, 50 kg ha^{-1} nitrogen and 50 kg ha^{-1} phosphorus as pure were applied, the top fertilizer was divided into two, and 90 kg ha^{-1} nitrogen was applied during the tillering period, and 60 kg ha^{-1} nitrogen was applied during the tillering period. Harvest was done in the first week of July in both growing seasons. In the study, parameters such as spike length, number of spikelets per spike, grain number per spike, grain weight per spike, thousand kernel weight, and grain yield were evaluated.

The data was analyzed using JMP 10 statistical analysis program (JMP, 2010), and the comparisons among the averages of the traits with differences were evaluated with the Duncan multiple comparison test.

RESULTS AND DISCUSSION

The mean values of the spike length and the number of spikelets per spike of the triticale genotypes in the experiment are given in Table 1. In terms of spike length and the number of spikelets per spike, the year and genotype × year interaction was statistically insignificant, but the difference among genotypes was significant (Table 1).

The average spike length varied between 10.6 and 15.3 cm in the study's first and second years, averaging 10.7 to 14.8 cm in the first year and 10.6 to 15.82 cm in the second year. According to the average of the two years, the average spike length was found to be 12.65 cm. The first and second years' average spike lengths were 12.6 cm and 12.7 cm, respectivly.

The shortest spike length was recorded in the T-3 line (10.7 cm, 10.6 cm, 10.6 cm), and the longest spike length was recorded in cultivar Truva, according to data from the first, second, and combined years (14.8 cm, 15.8 cm, 15.3 cm). (Table 1). The spike length varies between 9.10 to 16.08 cm, according to different studies (Tayyar and Kahriman, 2016; Dolgun and Cifci Aydogan, 2019; Sirat et al., 2020; Gungor et al., 2022).

The genotypes ranged from 24.7 to 40.3 in terms of spikelets per spike in the first year and from 24.3 to 39.0 spikelets per spike in the second year (Table 1). The cultivar Truva had the highest number of spikelets in both the first and second years of the experiment (40.3, 39.0 respectively) whereas the T-3 (24.7, 24.3) line had the lowest spikelets per spike (Table 1). The values for the combined years show that each spike had between 24.5 and 39.7 spikelets. The maximum number of spikelets per spike were found in the Truva (39.7), T-2 (33.7), and Özer (33.5) genotypes. The lowest number of spikelets per spike were determined in the T-3 (24.5), T-6 (25.5), and T-8 (25.7) lines (Table 1).; Senturk and Akgun (2014), Dolgun and Cifci Aydogan (2019), and Sirat et al. (2020), reported that the number of spikelets per spike varies between 21.1-24.8, 21.1-29.7, and 22.7-24.43, respectively.

Years were found to be insignificant in terms of the number of grains per spike, while the genotype × year interaction and genotypes were found to be statistically significant (Table 2). The number of grains per spike varied between 46.7-82.3 in the first year, 50.7-93.3 in the second year, and 48.8-87.8 in the average of years in triticale genotypes (Table 2). The highest number of grains per spike in the first year, the second year, and the average of two years were found in the T-2 line (82.3, 93.3, 87.8) whereas the lowest grain number per spike was found in the T-3 (46.7) line in the first year, T-1 (50.7) line in the second year T-3 (48.8) line in the average of the years (Table 2). According to the studies of Dolgun and Cifci Aydogan (2019), Oral and Ulker (2020), Sirat et al. (2020), and Gungor et al. (2022), the number of grains per spike varied between 34.3-54.3, 37.4-42.7, 42.28-59.32, and 53.2-79.9, respectively

In terms of grain weight per spike, the difference between years and genotype × year interaction was insignificant, but the difference among genotypes was statistically significant (Table 2)

In terms of grain weight per spike, it varied between 3.998-4.251 g in the first year, 2.532-4.525 g in the second year, and 2.518-4.261 g in the average of years. In the first year of the study, the highest grain weight per spike was determined in the T-9 (4.251 g) and T-2 (3.998 g) lines and the lowest grain weight per spike was determined in T-7 (2.347 g) and T-3 (2.438 g) lines. In the second year of the experiment, the highest grain weight per spike were determined in the T-2 (4.525 g), and T-10 (4.356 g) lines and the lowest grain weight per spike was determined in T-6 (2.532 g) and T-3 (2.598 g) lines. When the average of years was examined, the lowest grain weight per spike was found in the T-3 (2.518 g) line, and the highest grain weight per spike was determined in the T-2 (4.261 g) line (Table 2). In similar studies, the grain weight per spike was determined by Senturk and Akgun (2014), 1.25-1.51 g; Dolgun and Cifci Aydogan (2019), 1.5-2.8 g, Sirat et al. (2020), 1.98-2.66 g, Gungor et al. (2022), reported that it varies between 2.32-3.61 g. In the study, the findings obtained with grain weight per spike were similar to the

Table 1. Average of triticale genotypes of spike length (cm) and number of spikelets per spike

Genotypes	Spike length (cm)			Number of Spikelets/Spike (no)		
	2020-2021	2021-2022	Mean	2020-2021	2021-2022	Mean
Özer	14.1 ab	13.5 bcd	13.8 bc	33.0 b	34.0 bc	33.5 b
Truva	14.8 a	15.8 a	15.3 a	40.3 a	39.0 a	39.7 a
Karma-2000	11.2 gh	12.6 b-e	11.9 ef	29.0 cd	31.7 bcd	30.3 cd
Alperbey	12.8 cde	12.7 b-e	12.7 de	26.6 de	28.6 d-g	27.7 ef
Tatlıcak-97	12.3 def	12.1 d-g	12.2 def	33.0 b	31.7 cde	31.8 bc
T-1	11.6 fgh	11.5 efg	11.5 f	27.3 cde	27.0 f-ı	27.2 ef
T-2	14.0 ab	13.9 b	13.9 b	32.7 b	34.7 b	33.7 b
T-3	10.7 h	10.6 g	10.6 g	24.7 e	24.3 ı	24.5 g
T-4	14.1 ab	14.1 b	14.1 b	28.7 cd	28.3 d-h	28.5 de
T-5	11.3 gh	11.4 efg	11.3 fg	28.3 cd	27.3 e-ı	27.8 ef
T-6	11.9 efg	11.0 fg	11.4 fg	26.0 de	25.0 hı	25.5 fg
T-7	12.1 efg	12.2 def	12.1 def	26.6 de	28.3 d-h	27.5 ef
T-8	11.4 fgh	12.3 c-f	11.8 f	26.0 de	25.3 ghı	25.7 fg
T-9	13.8 bc	13.8 bc	13.7 bc	27.3 cde	26.6 ghı	27.0 ef
T-10	13.2 bcd	12.7 b-e	12.9 cd	30.3 bc	30.3 def	30.3 cd
Year mean	12.6	12.7	12.65	29.3	29.4	29.35
Genotype (G)	**	**	**	**	**	**
Year (Y)		ns			ns	
G x Y		ns			ns	

** Significant P < 0.01, * significant P < 0.05, and ns: not significant

Table 2. Average of triticale genotypes of number of grains per spike and grain weight per spike (g)

Genotypes	Grain number/spike (no)			Grain weight/spike (g)		
	2020-2021	2021-2022	Mean	2020-2021	2021-2022	Mean
Özer	80.0 abc	73.3 bc	76.7 ab	3.556 abc	3.661 a-d	3.608 abc
Truva	81.0 ab	70.0 bcd	75.5 bc	3.615 abc	3.025 cde	3.320 bcd
Karma-2000	59.3 def	79.3 ab	69.3 b-e	2.708 cd	3.563 a-e	3.136 b-e
Alperbey	64.0 cde	66.0 b-e	65.0 c-f	2.984 bcd	2.735 cde	2.860 de
Tatlıcak-97	64.7 b-e	63.3 b-e	64.0 def	3.062 bcd	3.251 cde	3.157 b-e
T-1	51.3 ef	50.7 e	51.0 gh	3.043 bcd	2.770 cde	2.906 cde
T-2	82.3 a	93.3 a	87.8 a	3.998 ab	4.525 a	4.261 a
T-3	46.7 f	51.0 e	48.8 h	2.438 d	2.598 de	2.518 e
T-4	73.6 a-d	74.3 bc	74.0 bcd	3.708 abc	3.363 b-e	3.535 a-d
T-5	57.7 def	58.7 cde	58.2 e-h	3.156 a-d	3.360 b-e	3.258 bcd
T-6	77.0 abc	58.3 cde	67.7 b-e	3.557 abc	2.532 e	3.045 cde
T-7	51.6 ef	72.3 bc	62.0 efg	2.347 d	3.759 abc	3.053 cde
T-8	57.0 def	55.0 de	56.0 fgh	3.071 bcd	3.444 b-e	3.258 bcd
T-9	81.0 ab	69.6 bcd	75.3 bc	4.251 a	3.360 b-e	3.805 ab
T-10	67.3 a-e	71.3 bc	69.3 b-e	3.235 a-d	4.356 ab	3.796 ab
Year mean	66.3	67.1	66.7	3.249	3.353	3.301
Genotype (G)	**	**	**	*	*	**
Year (Y)		ns			ns	
G x Y		*			ns	

** Significant P < 0.01, * significant P < 0.05, and ns: not significant

Table 3. Average of triticale genotypes of thousand kernel weight (g) and grain yield (kg da^{-1})

Genotypes	Thousand Kernel Weight (g)			Grain Yield (kg/da)		
	2020-2021	2021-2022	Mean	2020-2021	2021-2022	Mean
Özer	41.3 e-h	32.0 f	36.6 ef	994.6 ab	1043.8 ab	1019.2 ab
Truva	41.9 efg	36.0 d	39.0 c	939.7 bc	1034.5 ab	987.1 bc
Karma-2000	45.5 cd	28.9 h	37.2 de	833.2 cd	1013.7 abc	923.5 cd
Alperbey	39.2 ghı	31.6 fg	35.4 fg	830.6 cd	817.6 de	824.1 ef
Tatlıcak-97	38.1 hı	30.4 g	34.3 g	712.8 e	834.8 de	773.8 efg
T-1	37.9 ı	36.9 cd	37.4 cde	719.5 de	978.3 bc	848.9 de
T-2	42.6 def	34.5 e	38.6 cd	732.5 de	707.9 f	720.2 g
T-3	42.1 efg	34.6 e	38.4 cd	649.7 e	865.6 de	757.6 fg
T-4	44.5 de	38.4 b	41.5 b	862.4 c	985.3 bc	923.8 cd
T-5	55.2 a	38.3 b	46.8 a	1072.3 a	1114.6 a	1093.4 a
T-6	40.2 f-ı	38.0 bc	39.1 c	721.5 de	785.8 ef	753.7 fg
T-7	41.7 efg	35.6 de	38.7 cd	928.1 bc	1088.4 a	1008.2 b
T-8	44.3 de	41.7 a	43.0 b	997.7 ab	1106.1 a	1051.9 ab
T-9	48.7 bc	35.7 de	42.2 b	1058.6 a	1038.7 ab	1048.7 ab
T-10	49.6 b	36.7 d	43.2 b	924.5 bc	914.6 cd	919.6 cd
Year mean	43.5 a	35.3 b	39.4	865.2 b	955.3 a	910.3
Genotype (G)	**	**	**	**	**	**
Year (Y)		**			**	
G x Y		**			**	

** Significant P < 0.01, * significant P < 0.05, and ns: not significant

results of Senturk and Akgun (2014), Dolgun and Cifci Aydogan (2019) and Sirat et al. (2020).

In terms of thousand kernel weight and grain yield, the variations among genotype, year, and genotype year interaction were found to be significant (Table 3). The genotypes' thousand kernel weights ranged from 37.9 to 55.2 g in the study's first year, from 28.9 to 41.7 g in the following year, and from 34.3 to 46.8 g on average throughout the two years (Table 3). According to the average of the two years, the average thousand kernel weight was 43.5 g in the first year, 35.3 g in the second year, and 39.4 g in the average year. The highest thousand kernel weight was determined in the T-5 (55.2 g) line in the first year, the T-8 (41.7 g) line in the second year, and the T-5 (46.8 g) line in the average of years, whereas the lowest thousand kernel weight in the first year T-1 (37.9 g) line, Karma-2000 (28.9 g) line in the second year and Tatlıcak-97 (34.3 g) line in the average of two years (Table 3). They noted that the thousand kernel weight varied between 24.64-40.30 g in different ecological conditions (Lermi and Palta, 2018; Mut and Erbas Kose, 2018; Dolgun and Cifci Aydogan, 2019; Gungor et al., 2022).

In terms of grain yield, it varied between 712.8-1072.3 kg da^{-1} in the first year, 707.9-1114.6 kg da^{-1} in the second year, and 720.7-1093.4 kg da^{-1} according to the combined years, and the average grain yield was determined as 910.3 kg da^{-1} (Table 3). T-5 (1093.4 kg da^{-1}), T-8 (1051.9 kg da^{-1}), T-9 (1048.7 kg da^{-1}) lines, and Özer (1019.2 kg da^{-1}) cultivar had the highest grain yield, according to the average of the years. Low grain yield was obtained in T-2 (720.2 kg da^{-1}), T-3 (757.6 kg da^{-1}) lines, and Tatlıcak-97 (773.8 kg da^{-1}) variety (Table 3). In the studies of Senturk and Akgun (2014), Lermi and Palta (2018), Dolgun and Cifci Aydogan (2019), Mut and Erbas Kose, (2019), and Gungor et al. (2022), the grain yield was found to be varying between 475.0-564.0 kg da^{-1}, 325.8-805.8 kg da^{-1}, 189.2-314.2 kg da^{-1}, 230.4-366.1 kg da^{-1}, and 553.9-680.0 kg da^{-1}, respectively. In the study, the findings with the grain yield were higher than the results of previous studies suggesting that grain yield differs according to genetic structure, environmental factors and cultivation techniques (Senturk and Akgun, 2014; Mut and Erbas Kose, 2018; Gungor et al., 2022).

CONCLUSION

This study was carried out to evaluate five cultivars and 10 advanced triticale lines under Duzce ecological conditions. It was concluded that it would be appropriate to conduct experiments with the T-5, T-8 and T-9 lines standing out in grain yield in other regions where triticale cultivation is carried out.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

Ethics committee approval is not required.

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Data availability

Not applicable.

Consent for publication

Not applicable.

REFERENCES

Dolgun, C. and Cifci Aydogan, E., 2019. Determination of yield and quality characteristics of some triticale genotypes in Bursa ecological conditions. KSU J. Agric Nat 22(5), 664-671. https://doi.org/10.18016/ksutarimdoga.vi.518718

Gungor, H., Cakir, M.F. and Dumlupinar, Z. (2022). Evaluation of Triticale: Genotype by Environment Interaction and GGE Bıplot Analysis. Journal of Animal and Plant Sciences, 32(6), 1637-1647. https://doi.org/10.36899/JAPS.2022.6.0573

JMP, (2010). JMP User Guide, Release 10 Copyright © 2010, SAS Institute Inc., Cary, NC, USA, ISBN 978-1-59994-408-1. Retrieved from: http://www.jmp.com/getstarted

Lermi, A.G. and Palta, S. (2018). Research on seed yield of different triticale (x *Triticosecale* Wittmack) cultivars in West Black Sea eology. Journal of Bartin Faculty of Forestry, 20(2), 366-372. https://doi.org/10.24011/barofd.442283

Lukaszewski, A.J. and Gustafson, J.P.D. (1987). Cytogenetics of triticale. Plant Breed. Rev, 5, 41-93. https://doi.org/10.1002/9781118061022.ch3

Mut, Z. and Erbas Kose, O.D. (2018). Grain yield and some quality properties of triticale genotypes. Anadolu J. Agr Sci, 33, 47-57. https://doi.org/10.7161/omuanajas.336108

Oral, E. and Ulker, M. (2016). Path analysis and relations between features in triticale (x *Triticosecale* Witmack) varieties. Iğdır Univ. J. Inst. Sci. & Tech. 6(3), 153-160. Retrieved from: https://dergipark.org.tr/en/pub/jist/issue/34622/387915

Senturk, S. and Akgun, I. (2014). Determination of yield and yield components of some triticale genotypes grown in Western Transition Zone. Journal of the Faculty of Agriculture, 9(1), 16-26. Retrieved from: https://dergipark.org.tr/tr/download/article-file/308664

Sirat, A., Bahar, B. and Bahar, N. (2020). A research on grain yield and yield components of triticale (x *Triticosecale* Wittmack) cultivars in continental climate and arid agricultural conditions of Eastern Black Sea Region. Journal of Bahri Dagdas Crop Research, 9 (2), 134-146. Retrieved from: https://dergipark.org.tr/tr/pub/bdbad/issue/58586/846529

Tayyar, S. and Kahriman, F. (2016). Determination of yield and some quality characteristics of triticale genotypes grown under Biga conditions. Journal of Adnan Menderes University Agricultural Faculty, 13(2), 23 – 31. https://doi.org/10.25308/aduziraat.293416

TUIK, 2022. Turkish Statistical Institute. Retrieved from: https://www.tuik.gov.tr (Accessed date: October 20, 2022).

Villegas, D., Casadesus, J., Atienza, S., Martos, V., Maalouf, F., Karam, F., Aranjuelo, I., Nogues, S. (2010). Tritordeum, wheat and triticale yield components under multi-local Mediterranean drought conditions. Field Crops Res., 116, 68-74. https://doi.org/10.1016/j.fcr.2009.11.012