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Determination of Yield, Quality and Winter Hardiness Characteristics of Some Triticale (x*Triticosecale* Wittmack) Genotypes in Pasinler and Erzincan Locations

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ABSTRACT

Triticale (x*Triticosecale* Wittmack) is a grain used in animal feed and is known for its high efficiency, high nutritional quality and resistance to stress factors. Triticale is an alternative plant used for the utilization of marginal areas due to these properties. This study was carried out at two different locations in Erzincan Merkez and Pasinler districts of Erzurum province. Two registered triticale varieties (Umranhanım and Tatlıcak 97) and 13 triticale lines in the advanced breeding stage were assessed comparatively in terms of efficiency, quality and cold resistance parameters. As a result of this study, genotypes 9, 10 and 12 were found suitable for the conditions of the region and considered to have a profitable production potential for producers. The Umranhanım cultivar is prominent in terms of its resistance to cold and its yield. In addition, it has been concluded that it is important to include cold test studies in breeding programs in regions where winter damage is experienced intensively as well as included in the selections

***Keywords*:** Triticale, yield, quality, winter hardiness.

Introduction

Genetically, Triticale (x*Triticosecale* Wittmack) is a cool climate cereal type obtained by hybridizing wheat and rye. Triticale obtained as a result of hybridization, aiming to combine the yield and quality of wheat with the high adaptability of rye, is grown in large areas in many countries around the world. Triticale can generate more yield than wheat, especially in barren regions where soil depth is not suitable for wheat cultivation and winters are severe. It is an important grain in human and animal nutrition due to high grain and green grass yield, rapid growth and development and high lysine content. In the evaluation of marginal areas, it is stated that triticale is the priority plant that is capable to increase the cultivation areas and production significantly with the development of new varieties (Müntzing 1989; Mergoum et al., 1992; Kun 1996).

Due to limitations in intensive agriculture and possible climatic changes, it will not be easy to increase the production to the extent that it will feed the growing world population. Therefore, the aim is to grow plant species which are more efficient in marginal soils. These plant species should be able to produce high yields with low inputs in marginal or low yield areas. Although, triticale is a newly cultivated plant species, it is rapidly spreading to various production systems (Pfeiffer 1994).

Soil conditions, such as drought, pH level, salinity, lack of trace elements and toxicity are factors limiting grain yield. Triticale is an advantageous plant in such conditions compared to commonly grown cereals. In fact, triticale has replaced rye and winter barley in saline soils in Belgium. In our country, it should be considered as an alternative crop in areas where winter barley cannot be cultivated due to winter damage to reduce the feed gap. The results obtained from the studies have shown that triticale is an alternative crop to other cereals, especially wheat and barley (Benbelkacem 1998; Maças et al., 1998; Royo and Aragay 1998).

As a result of studies, it has been determined that triticale can give better benefit than other grains such as wheat, barley and oats (Gregory 1975). It is better adapted to sloping areas than wheat and barley and that it yields more than wheat in areas where soil depth is not suitable for wheat cultivation, the soil is barren and winters are severe (Martin and Maurer 1974; Rossi 1980; Yagbasanlar 1987). Since triticale is more efficient than other grain types in arid conditions, it is also important for regions where annual precipitation is limited and where irrigation is not possible (Salmon et al., 1996).

Considering the climate and geographic structure of the Eastern Anatolia Region, it is one of the most suitable regions for triticale farming. Therefore, it would be beneficial to develop and increase the production of new triticale varieties that can be offered to regional farmers. Today, triticale farming is mostly carried out to obtain animal feed (Dodge, 1989). Considering this aspect, triticale may be an alternative forage crop in areas which are important animal husbandry centers. (Farrel et al., 1983; Varughese et al., 1986; Belaid 1994; Pfeiffer 1994; Saade, 1995).

Due to the above mentioned characteristics, it is considered that triticale is an important alternative crop plant in Eastern Anatolia Region, especially in areas where wheat yield is low and unused barren land available for utilization. Therefore, it is important that triticale varieties which are suitable for the ecological conditions of the region and have high efficiency and yield stability are developed and offered to farmers. However, in addition to the genetic yield potential of a variety, the environmental conditions in which the plants are grown are also influence the yield. Under such circumstances, the stability of yield in various environmental conditions is of great importance. Therefore, it is necessary to determine that which genotypes have a stable yield under different environmental conditions. The aim of this study was to determine high efficiency, winter resistant and high quality genotypes that could be grown in Erzurum and similar ecological conditions.

Materials and Methods

The trial was carried out for one year during 2017-18 in the trial areas in Erzurum, Pasinler district and Erzincan province under dry conditions. Umranhanım and Tatlıcak 97 types and 13 triticale lines were used in the study. The pedigrees and origin of the lines used in the trial are given in Table 1.

The winter season trial was established in two different locations in the "Chance Connected Full Blocks" trial design with three replications (Yildiz and Bircan 1991). Treatments were distributed to the parcels according to chance (Little and Hills 1978; Yildiz and Bircan 1991; Mead et al., 1994). Each parcel consisted of 6 plant rows of 6 m in length with 20 cm spacing, and the area of a parcel was 7.2 m² (6 m length x 1.2 m width).

Since there is no recommended date for planting triticale, the planting for the trial was carried out between the dates of September 1 and October 1 which is the most suitable date for planting winter wheat (Özcan and Acar 1990). The seeds were sown with row spacing 20cm apart at a depth of 4 - 6 cm and 475 seeds per m^2 with a seed drill. Ammonium nitrate (26%) was used as a nitrogen fertilizer source. Half of the nitrogen fertilizer was applied during sowing and the half during bolting at a rate of 6 kg N and 6 kg P_2O_5 per decare while the Phosphor fertilizer was all applied with the planting (Kıral and Özcan 1990; Akkaya 1993). Weed control was carried out during the tillering period in rainless and windless weather using the 2,4-D herbicide at a rate of 200 cc /da (Özcan 1994).

When the wheat reached at harvestable maturity, 50 cm was cut off from each parcel as edge effect and the remaining parts were harvested and blended with a parcel harvester. (Kıral and Özcan 1990; Akkaya 1993).

The observations were recorded on number of grains per Square Meter; maturation period, spikes in a row in the randomly selected one meter area within the harvest area of each plot were counted and these values were converted to the number of spikes per square meter.

Grain Yield: The grain product collected from each parcel was harvested and blended and weighed after cleaning with a small selector. The grain yields obtained as a result of weighing were collected and converted to kg / da.

1000 Grain Weight: Each piece of grain taken from the product was counted and weighed four times as 100 grains and the average was taken and multiplied with 10 to determine the 1000 grain weight (g).

Hectoliter Weight: A hectoliter measuring tool was used to weigh the grain product obtained from each parcel, weighed and calculated in kg.

Protein in Grain; Sample of wheat taken from each parcel was milled. As a result, obtained rate 100 g flouver was determined via NIR in %. Cold test studies were carried out according to the method used by Kucukozdemir (2016).

Statistical Analysis; The data were determined according to analysis of variance using SPSS 10.0 software package and when the medium was determined, Duncan's Multiple Range Test was used.

Results and Discussion

In the study conducted with fifteen triticale genotypes, significant statistical differences were found among the characteristics of the examined genotypes in Erzincan location in parameters other than hectoliter weight and spike number per m^2. The mean values of all these properties and the statistical groups of the factors according to these averages (P <0.01 and P <0.05) are given in Table 2, 3, 4 and 5**.**

When investigated the location yields, overall means in the locations and Pasinler location were found significant according to p<0.01 and Erzincan location was calculated important according to p<0.05. In number of spikes per m^2, the locations and location averages were determined statistically significant according to p<0.01.

According to the location average Umranhanım variety (347 kg/da) had the highest grain yield, the values of genotype no. 10 (343 kg/da) and no. 12 (340 kg/ha) were very close to Umranhanım. Genotypes 1 (330 kg/da), 7 (307 kg/da), 9 (300 kg/da) and 8 (292 kg/da) were statistically in the same group with the maximum value. Genotypes 10 (553 kg/da), 12 (549 kg/da) and Umranhanım (540 kg/da) in Pasinler location were prominent with grain yield. In Erzincan, the highest grain yield was recorded in genotype no. 8 (184 kg/da) (Table 2). Kucukozdemir et al., (2016) carried out a study under Erzurum conditions for 10 years with 4 triticale and 3 wheat varieties to obtain the highest and stable grain yield of 418.9 kg/da with Umranhanım. Again, in a study on triticale in Erzurum's arid conditions, the total yield was between 219.9-466.6 kg /da and the differences between the Triticale genotypes were considered significant.

The highest number of spikes per m^2 in terms of location averages was found in genotype 4 (534) and genotypes other than Umranhanım, varieties 3, 8, 12 and 13 were determined to be statistically in the same group with maximum genotype. In Pasinler location, the highest number of spikes per m^2 was determined in genotypes 5 (675) and 4 (665), while the highest number of spikes per m^2 in Erzincan was determined in Tatlıcak 97 (435) variety. There were very significant differences between the genotypes in both locations (Table 2). The number of spikes per m^2 is one of the most important factors affecting yield and is highly influenced by environmental factors (Olgun et al., 1999). As a matter of fact, in a study on Triticale, the direct contribution of the spike number per m^2 on yield was calculated as 86.99% and the indirect contribution was calculated as 13.01% (Akgün et al., 1997). In a study carried out by Kucukozdemir (2002) in 5 locations, the lowest average number of spikes per m^2 was obtained in the Van location (202 units) and the highest in the Mus location (428.9 units). The reason for the significant differences in spike number per m^2 in this study is attributed to the climate factors of the locations and especially the difference in precipitation. In a study carried out by Akgün et al., (1997), they found that the number of spikes per m^2 among triticale varieties/lines ranged from 71.8 to 178.50 and the differences between genotypes were statistically insignificant. In another study in which summer cultivation was carried out in Erzurum's environmental conditions using 17 triticale genotypes and 1 bread wheat variety, it was manifested that the number of spikes per m^2 for the triticale genotypes and wheat ranged between 292.99 and 490.00, respectively (Tosun et al., 2000). In a trial carried out to compare Cumhuriyet 75 and Gediz 75 wheat varieties and triticale lines under Bornova conditions, the number of spikes per m^2 varied between 262.0-396.9, 269.4-396.9 and 312-390, respectively (Demir et al., 1981).

Both in terms of plant height and 1000 grain weight, according to the results of variance analysis, location averages and Erzincan location were found to be statistically significant (P<0.01) and Pasinler location was found significant (P<0.05).

The highest plant height according to location averages was found in Umranhanım (99.3 cm) and Tatlıcak 97 (99.3 cm) varieties and genotypes other than 5, 6 and 7 were statistically in the same group with maximum genotypes. In terms of plant height, Umranhanım (127 cm) was the tallest genotype in Pasinler location, while genotypes other than genotype 5 in this location were statistically in the same group as Umranhanım variety (Table 4). In the Erzincan location, genotype (75.7 cm) was found to be prominent while there were very significant differences between the genotypes. Demir et al., (1981) carried out a trial in triticale variety yield under Bornova conditions and determined that the most productive triticale lines in the experiment varied between 108.0-114.2 cm. Geren et al., (2012) studied some features regarding the grain yield and yield in general of different triticale varieties (Tacettinbey, Egeyıldızı, BDMT 06-5K, Karma, Tatlıcak 97, Mikham-2002, Focus, Melez-2001, Presto) under the environmental conditions of Menemen-İzmir during 2009-2011 and determined that there were significant differences in terms of plant height (87.7-119.2 cm).

In this study, the maximum value in terms of the location averages for 1000 grains was obtained from genotype 5 (43.5 g) while genotype 12 (42 g), genotype 7 (42 g), Tatlıcak 97 variety (41), genotype 3 (41.5 g), genotype 6 (41.5 g), genotype 10 (41.5 g), genotype (41 g) and genotype 11 (40 g) were statistically in the same with the genotype with maximum value. The highest 1000-grain weight was obtained from genotypes 5 (45 g), 7 (44 g) and 6 (42 g) respectively in Pasinler location and all genotypes except Umranhanım and genotype 1 were statistically in the maximum group. In Erzincan, the highest1000-grain weight was measured in Tatlıcak 97 cultivars (44 gr) and no. 3 genotype (44 gr), and the differences between genotypes were statistically very significant (Table 2). Thousand grain weight is one of the important characteristics affecting grain yield in cereals (Tosun and Yurtman 1973; Gençtan and Sağlam 1987). Similarly, to this study, Tosun (1995) carried out a study by using 10 triticale species / lines in a greenhouse study reporting a 1000-grain weight of 32.3-45.49 (mean 39.03 g) and the differences between genotypes were considered to be very significant Tosun et al., (2000) carried out another study in Erzurum which reported a 1000-grain weight between 32.98 - 39.39 g and the differences between genotypes were determined to be significant. Likewise, a study carried out by Kumar et al., (1987) with six triticale varieties manifested a 1000 grain weight between 32.11-43.55 g as well as significant differences between the varieties.

When examined of Grain protein ratio, location averages and Erzincan location were detected statistically ($P<0.01$) significant and location averages were determined according to $P<0.05$. In Pasinler location was not found to be statistically significant. There were no statistically significant differences between the locations and Location average in terms of hectoliter weights.

While there was no statistical difference between the protein ratios of genotypes in Pasinler location, the highest protein ratio average among the locations was measured in genotype 2 (15.5%). According to the location averages, all genotypes except 3, 7, 8 and 13 were statistically in the same maximum group. In the Erzincan location, it was recorded that genotype 2 (17.1%) came to the forefront and statistically Umranhanım and Tatlıcak 97 were in the same group as the maximum group (Table 4). Similarly, to this study, Demir et al., (1981) in a study conducted under Bornova conditions, the highest yield triticale lines manifested a grain protein ratio varying between 10.66-13.05%. The chemical composition of triticale grain is similar to that of other grains, with a significant proportion (about 80%) of carbohydrates and about 95% of the carbohydrates is comprised of starch. Protein ratio is between 10% and 20%, fat ratio is between 2-4%. The percentage of carbohydrates decreases as wrinkles increase in seeds whereas protein and fat content increases. Therefore, as a result of breeding studies to reduce wrinkles, wrinkles have decreased, however the protein ratio has decreased. The amount of protein is related to the ratio of endosperm to pericarp and aleurone and the increase in grain size (increase in the amount of starch in the endosperm) can change this ratio. The recently obtained protein content of triticale is equivalent to wheat. However, the biological value of the protein in triticale is higher than in wheat (Skowmand et al., 1984; Dodge 1989) and has a balanced acid composition (Shealy and Simmonds 1973). In a study carried out in Erzurum with 14 triticale genotypes for 2 years, the hectoliter weights of the genotypes according to years were determined as 75.20-80.00 kg/hl, 73.20-79.60 kg/hl, respectively; 1000 grain weights were 25.50-33.50 g, 37.50-49.20 g, grain protein ratios were between 13.83-15.20%, 11.28-13.27%, respectively. It is reported that the precipitation especially in June and July 2016 increased the 1000 grain weights and yields however protein ratios decreased (Kucukozdemir et al., 2018).

According to the results of variance analysis, significant statistical differences were found in the vitality in coldness rates in this study ($P<0.01$). In the first test of the study at -17°C, the highest viability rate was found in genotype 2 (97%), followed by 10 (93%), 8 (90%) and Umranhanım variety (90%), respectively. Statistically, genotype 1 (87%), 11 (87%), 9 (83%), Tatlıcak 97 variety (83%), genotypes 5 and 13 (80%) were statistical in the same group with maximum genotypes in this test rating. Umranhanım varieties (70%) had the highest vitality ratio at -19°C while genotypes 10 (67%) and 2 (53%) were statistically ($P<0.05$) in the same group with Umranhanım variety. Statistically, Umranhanım variety (60%) and genotype 10 (50%) manifested significant vitality compared to the other genotypes at -21^{0}C de (Table 5). Triticale cultivation in winter and dry conditions exposes the plant to cold and drought in the winter. This is also the case in our other regions. The output of varieties that are resistant to winter and cold after winter is 80-95%, while the output of the fragile varieties is down by 40-50% (Kucukozdemir 2016).

Conclusion

The yields, the number of spikes per square meter, hectoliter weight, protein content and performance in 3 different cold temperatures (-17, -19 and -21°C) of the candidate varieties have been compared with the varieties in the study. In terms of parameters other than hectoliter weight, significant differences were determined between the genotypes. It has been determined that in terms of 1000 grain weight, yield, spike number per m^2, protein ratio, plant height and resistance to cold of genotypes 9, 10 and 12 are suitable for the regional conditions and have a profitable production potential for producers. Umranhanım varieties were found to stand out in terms of durability and yield. This is due to the maximum adaptation capability of the variety in the region where all varieties are developed. In addition, it is a very important that cold resistance observations are included in the breeding programs in regions such as East Anatolia with severe winters and high risk of frost to avoid producers in the region from being affected by winter damage and have a more efficient production.

Table 1. Genotypes used in the trial

Pedigrees of the genotytpes	
Umranhanım	
Tatlıcak 97	
Genotype no.1	CIMMYT-1/MİKHAM-2002
Genotype no.2	FAHAD_5/MİKHAM-2002
Genotype no.3	ANOAS-3/GNU-14-1//KARMA
Genotype no.4	POLLMER_2//GNU_7-2/NING7840/3/ZEBRA79/.../4/MİKHAM-2002
Genotype no.5	CT179.80/3/150.83//2*TESMO_1MUSX603/01-02KTVD-17
Genotype no.6	CT179.80/3/150.83//2*TESMO_1MUSX603/01-02KTVD-17
Genotype no.7	CT179.80/3/150.83//2*TESMO_1MUSX603/01-02KTVD-17
Genotype no.8	6TB219/3/6TA876//6TB163/6TB164/4/2* ...../5/ANOAS-3/GNU-14-1
Genotype no.9	CT179.80/3/150.83//2*TESMO_1MUSX603/01-02KTVD-17
Genotype no.10	LAD 183/PORSAS_2
Genotype no.11	05-06 TRİ-DİALLEL-14
Genotype no.12	05-06 TRİ-DİALLEL-21
Genotype no.13	CT776.81//TESMO-1/MUSX 603/3/BAGAL_3/FARAS_1/3/ARDI_TOPO1419//ERIZO_9

Table 2. Grain yield and number of spikes per m^2

	Grain yield (kg/da)			Spikes per m^2 (Grain)		
Genotypes	Erzincan	Pasinler	Location average	Erzincan	Pasinler	Location average
Umranhanım	153 a-d*	540 a	347 a	389 ab	381 cd	385 cd
Tatlıcak 97	116 b-d	501 ab	308 a-c	435 a	511 a-c	473 a-c
Genotype 1	146 a-d	514 ab	330 ab	304 cd	568 a-c	436 a-d
Genotype 2	133 a-d	398 c	265 cd	248 c	415 b-d	331 de
Genotype 3	122 a-d	385 c	253 cd	349 a-c	493 a-c	421 a-d
Genotype 4	103 de	373 c	238 d	403 ab	665 a	534 a
Genotype 5	139 a-d	366 c	253 cd	328 a-c	675 a	501 a-c
Genotype 6	135 a-d	429 bc	282 b-d	351 a-c	513 a-c	432 a-d
Genotype 7	173 ab	440 bc	307 a-c	437 a	600 ab	519 ab
Genotype 8	184 a	400 c	292 a-d	348 a-c	460 a-c	404 b-d
Genotype 9	165 a-c	434 bc	300 a-c	297 cd	549 a-c	423 a-d
Genotype 10	133 a-d	553 a	343 a	337 a-c	611 ab	474 a-c
Genotype 11	88 e	194 d	141 e	333 a-c	489 a-c	411 a-d
Genotype 12	130 a-d	549 a	340 a	311 cd	376 cd	343 de
Genotype 13	127 a-d	136 d	131 e	285 cd	229 d	257 e
Total	137*	414**	275**	344**	502**	423**

(*) According to the Duncan test, the averages shown with the same letter are not important in their group. ($p<0.05$)

Table 3. Plant height and 1000 grain weight

	Plant height (cm)			1000 grain weight (gr)		
Genotypes	Erzincan	Pasinler	Location average	Erzincan	Pasinler	Location average
Umranhanım	72 a-d*	127 a	99,3 a	32 e	34 b	33 e
Tatlıcak 97	73,0 a-c	126 ab	99,3 a	44 a	39 ab	41,5 ab
Genotype 1	62,3 c-e	122 ab	92,3 a-d	42 ab	34 b	38 b-d
Genotype 2	69,0 a-e	118 ab	93,7 a-d	30 e	43 a	36,5 de
Genotype 3	61,7 de	118 ab	89,8 b-d	44 a	39 ab	41,5 ab
Genotype 4	66,7a-e	119 ab	92,8 a-d	38 c-d	38 ab	38 b-d
Genotype 5	63,7 b-e	111 b	87,3 d	42 ab	45 a	43,5 a
Genotype 6	64,0 b-e	116 ab	89,8 b-d	41 a-c	42 a	41,5 ab
Genotype 7	63,3 b-e	114 ab	88,7 cd	40 bc	44 a	42 ab
Genotype 8	70,0 a-e	117 ab	93,7 a-d	36 d	38 ab	37 cd
Genotype 9	60,7 e	126 ab	93,2 a-d	41 a-c	41 ab	41 a-c
Genotype 10	74,3 ab	123 ab	98,7 ab	42 ab	41 ab	41,5 ab
Genotype 11	68,7 a-e	121 ab	94,7 a-d	39 b-d	41 ab	40 a-d
Genotype 12	75,7 a	121 ab	98,2 ab	42 ab	42 a	42 ab
Genotype 13	71,7 a-e	123 ab	97,5 a-c	38 c-d	39 ab	38,5 b-d
Total	67,8**	120*	93,9**	39,4**	40*	39,7**

(*) According to the Duncan test, the averages shown with the same letter are not important in their group ($p<0.05$)

Table 4. Grain protein ratio and plant height

	Grain protein ratio (%)			Hectoliter weight (kg)		
Genotypes	Erzincan	Pasinler	Location average	Erzincan	Pasinler	Location average
Umranhanım	16,1 ab*	12,5	14,3 ab	75,2	78,8	77
Tatlıcak 97	16,2 ab	12,6	14,4 ab	75,6	78,4	77
Genotype 1	14,9 b-d	12,6	13,7 ab	74,8	78,8	76,8
Genotype 2	17,1 a	13,9	15,5 a	74,4	77,2	75,8
Genotype 3	13,8 de	12,7	13,3 bc	74,8	77,2	76
Genotype 4	15,0 b-d	13,2	14,1 ab	75,2	78	76,6
Genotype 5	14,3 c-e	13,3	13,8 ab	77,2	79,2	78,2
Genotype 6	14,4 c-e	12,9	13,7 ab	77,2	78,8	78
Genotype 7	13,7 de	12,9	13,3 bc	76,8	80	78,4
Genotype 8	13,1 e	12,6	12,8 bc	71,6	75,2	73,4
Genotype 9	14,3 c-e	13,4	13,8 ab	77,2	78,4	77,8
Genotype 10	15,3 bc	12,2	13,7 ab	74,4	78,4	76,4
Genotype 11	14,8 b-d	13,3	14,0 ab	76	75,2	75,6
Genotype 12	15,5 bc	12,3	13,9 ab	72,8	78	75,4
Genotype 13	14,5 cd	9,0	11,8 c	73,5	78	75,75
Total	14,9**	12,6 ns	13,7*	75,1 ns	78,0 ns	76,5 ns

(*) According to the Duncan test, the averages shown with the same letter are not important in their group ($p<0.05$)

Table 5. Vitality rates at different cold temperatures

Genotypes	**-17°C (%)**	**-19°C (%)**	**-21°C (%)**
Umranhanım	90 ab*	70 a	60 a
Tatlıcak 97	83 a-c	47 c-e	30 b
Genotype 1	87 a-c	47 c-e	3 ef
Genotype 2	97 a	53 a-d	17 b-e
Genotype 3	50 f	20 f	0 f
Genotype 4	70 c-e	30 ef	10 c-f
Genotype 5	80 a-d	40 c-e	20 b-d
Genotype 6	60 ef	20 f	0 f
Genotype 7	63 d-f	50 b-d	23 bc
Genotype 8	90 ab	30 ef	7 d-f
Genotype 9	83 a-c	37 d-f	17 b-e
Genotype 10	93 ab	67 ab	50 a
Genotype 11	87 a-c	47 c-e	10 c-f
Genotype 12	77 b-e	57 a-c	13 c-f
Genotype 13	80 a-d	43 c-e	20 b-d
Total	79**	44**	19**

(*) According to the Duncan test, the averages shown with the same letter are not important in their group ($p<0.05$)

References

Akgün İ., Tosun M., and Sağsöz S., (1997). A research on yield and yield components of some triticale lines and cultivars under Erzurum ecological conditions. Journal of Atatürk University Faculty of Agriculture 28: 103 - 119.

Akkaya A., (1993). Effects of phosphorus rates and application methods on yield and some yield components of winter wheat. Journal of Atatürk University Faculty of Agriculture 2: 36 - 50.

Belaid A., (1994). Nutritive and economic value of triticale as feed grain for poultry. CIMMYT Economics Working Paper 94 - 01, Mexico, D.F. CIMMYT.

Benbelkacem A., (1998). Genetic Gain over more than two decades of triticale improvement in Algeria. Proceedings of the 4th International Triticale Symposium, Re Deer, Alberta, Canada, Vol. 2, 100 - 103.

Demir İ., Aydın N., and Korkut K. Z., (1981). Research on some agronomic characteristics of advanced triticale lines. Ege University Faculty of Agriculture Journal 18: 227 - 238.

Dodge B. S., (1989). Food and Feed Uses. In: Triticale – A promising Addition to the World's Cereal Grains. National Academic Press, Washington, D.C.1989, 42 -52.

Farrel D. J., Chen C., McCrae F., and McKenzie R.J., (1983). A nutritional evaluation of triticale with pigs. Animal Feed Science and Technology 9: 49 - 62.

Gençtan T., and Sağlam N., (1987). The effect of sowing time and sowing frequency on yield and yield components in three bread wheat varieties. Turkey Grain Symposium, 6-9 October Bursa 171-183.

Geren H., Geren H., Soya H., Ünsal R., Kavut Y. T,, Sevim İ. and Avcıoğlu R., (2012). Investigation on grain yield and other yield characteristics of some triticale cultivars grown in menemen conditions. Ege University Faculty of Agriculture Journal49 (2): 195-200.

Gregory R. S., (1975). Commercial production of triticale. Span18: 65 - 66.

Kıral A. S., and Özcan H., (1990). Seed, phosphorus and nitrogen application quantities of lancer winter bread wheat in Erzurum dry conditions. Eastern Anatolia Agricultural Research Institute Publication No: 5.

Kumar P., Kumar A., Asawa B. M., and Chauhan B. P. S., (1987). Factor analysis in triticale. İndian Journal of Agricultural Research. 21(1): 18 - 20.

Kün E., (1996). Tahıllar – I (Serin İklim Tahılları) AÜ. Z. F. Yy. No: 1451, Ders Kitabı: 431, Ankara, 321 s.

Kucukozdemir U., (2002). Determination of triticale genotypes in Eastern Anatolia. Msc. Thesis. Atatürk University Graduate School of Natural and Applied Sciences Field Crops Department of Cereals and Pulse Crops.

Kucukozdemir U., Bağcı A., and Aydoğan S., (2016). Stability comparison of bread wheat and triticale varieties in adverse environmental conditions. 1. International Conference on Triticale Biology, Breeding and Production. Polonia p 18 - 20

Kucukozdemir U., (2016). Determination of performance and cold tolerance of East Anatolian wheat landraces under Erzurum conditions. Ph.D. thesis. Atatürk University Graduate School of Natural and Applied Sciences Field Crops Department of Cereals and Pulse Crops.

Kucukozdemir U., Dumlu B., Çakal Ş., and Özlütürk A., (2018). Evaluation of some triticale genotypes in terms of yield and some yield and quality components in Erzurum conditions. 2. International Conference on Triticale Biology, Breeding and Production. Polonia.

Little T. M., and Hills F. J., (1978). Agricultural Experimentation Design and Analysis, John Wiley & Sons Company, Inc., USA, (2nd ed.) 298 p.

Maças B., Countinho J., and Bagulho F., (1998). Forage and pasture potential of triticale growing in marginal environments. The case of semi-arid conditions. proceedings of the 4th İnternational Triticale Symposium, Re Deer , Alberta, Canada, Vol. 2, 140 – 142.

Martin C. A., and Maurer O. R., (1974). Introduction, adaptation and selection of triticale at Apodaca, Neueve Leon. Field Crops Abst., 17, Abst. No: 6102.

Mead R., Curnow N., and Hasted A. M., (1994). Statistical Methods in Agriculture and Experimental Biology, Second Edition, Chapman & Hall Company, 412 p.

Mergoum M., Ryan J., Shroyer J. P., and Monem M. A., (1992). Potential for adapting triticale in Morocco. Journal of Natural Resources and Life Sciences Education, 21 (2): 137-141.

Müntzing A., (1989). Triticale results and problems. Advances in Plant Breeding. Supplement to Journal of Plant Breeding. Verlag Paul Parey. Berlin und Hamburg. 103 p.

Olgun M., Serin Y., and Partigöç F., (1999). Climate-yield relationship in wheat in Eastern Anatolia Region. GAP 1. Agriculture Congress, 26 - 28 May 1999, Sanlıurfa, 27 - 35.

Özcan H., and Acar A., (1990). The effects of sowing times of different wheat varieties on grain yield in Erzurum arid conditions. Eastern Anatolia Agricultural Research Institute Publication No: 3.

Özcan H., (1994). Research on Yield, Yield Components, Agronomic Characters and Quality Criteria in Some Winter Bread Wheat Varieties and Lines. Ph.D. Thesis. Atatürk University Graduate School of Natural and Applied Sciences Field Crops Department of Cereals and Pulse Crops.

Pfeiffer W. H., (1994). Triticale: potential and research status of a manmade cereal crop. Background Material for the Germplasm Improvement Subprogram External Review, Cd. Obregon, Son. Wheat Program. 82 - 92, Mexico, D.F. CIMMYT.

Rossi L., (1980). Potential of utilizing triticale as a food, feed and forage crop. Field Crop Abst. No: l33

Royo C., and Aragay M., (1998). Spring triticale grown for different end-uses in a Mediterranean-Continental area. Proceeding of the 4th International Triticale Symposium, Re Deer, Alberta, Canada, Vol. 2, 268 - 271.

Saade E. M., (1995). Triticale production and utilization in Tunisia: Constraints and prospects. CIMMYT Economics Working Paper, 95 - 104, Mexico, D.F CIMMYT.

Salmon D. F., Baron V. S., McLeod J. G., Helm J. H., Guedes-Pinto H., Darvey N., and Carnide V. P., (1996). Developments in plant breeding. Triticale: today and tomorrow, 5: 693 - 699.

Shealy H. E., and Simmonds D. H., (1973). The early developmental morphology of the triticale grain. İn: Proc. 4th International Wheat Genetic Symposium 256 - 270.

Skowmand B., Fox P. N.,Villarel R. L., (1984). Triticale in commercial agriculture. Progress and promise. Advances in Agronomy 37: 1 - 45

Tosun M., (1995). Determination of Some Cytological and Morphological Properties Affecting Grain Yield in Hexaploid Triticale Species / Lines. Ph.D. Thesis. Atatürk University Graduate School of Natural and Applied Sciences Field Crops Department of Cereals and Pulse Crops.

Tosun M., Akgün İ., Sağsöz S., and Taşpınar M., (2000). Determination of yield and yield components of some triticale genotypes. Journal of Atatürk University Faculty of Agriculture 31(1): 1 – 10.

Tosun O., and Yurtman N., (1973). Effective morphological and physiological properties of bread wheat (*Triticum aestivum* L. em Thell). Ankara University Faculty of Agriculture Yearbook 23: 418-434.

Varughese G., Sari E. E., and Abdalla O.S., (1986). Two decedes of triticale breeding and research at CIMMYT. Proc. of İnter. Triticale Symp. Sdney. Occasional Public N.24. Aust. Inst. of Agric. Sci. Australia, 148 – 169.

Yağbasanlar T., (1987). Investigations on the Main Agricultural and Quality Characteristics of Seven Triticale Cultivars Cultivated in Different Dates of Çukurova. Ph.D. Thesis, Çukurova University Graduate School of Natural and Applied Sciences Field Crops Department of Cereals and Pulse Crops.

Yıldız N., and Bircan H., (1991). Research and Trial Methods. Ataturk University Faculty of Agriculture Publication. No:14 p,152.

Rajaei A., Barzegar M., and Yamini Y., (2005). Supercritical fluid extraction of tea seed oil and its comparison with solvent extraction. European Food Research and Technology 220: 401-405.

Rajaei A., Barzegar M., and Sahari M. A., (2008). Comparison of antioxidative effect of tea and sesame seed oils extracted by different methods. J Agric Sci Technol 10: 345-350.

Roberts G R., and De Silva U. L. L., (1972). Products from tea seed 1. Extraction and properties of oil. Tea Q. 43 (3): 88-90.

Sahari M. A., Atai D., and Hamedi M., (2004). Characteristics of tea seed oil in comparison with sunflower and olive oils and its effect as a natural antioxidant. Journal of the American Oil Chemists' Society 81: 585-588.

Saklı A., (2011). A Critical Review of Recent Sectoral Structure Proposal for Turkish Tea Sector. Humanity & Social Sciences Journal 6 (1): 01-07.

Sengupta C., Sengupta A., and Ghosh A., (1976). Triglyceride composition of tea seed oil. J Sci Fd Agric 27: 1115-1122.

Seyis F., Yurteri E., Ozcan A., Savsatli Y., (2018). Organic Tea Production and Tea Breeding in Turkey: Challenges and Possibilities. Ekin J. 4(1):60-69.

Tekeli S. T., (1976). Çay yetiştirme işleme pazarlama. Dönüm Yayınlar, 5.Ankara: 8, 90–193. (Tea cultivation, processing and marketing) Dönüm publications: 5. Ankara 8, 90-93)

Wachira F. N., Waugh R., Hackett C. A., and Powell W., (1995). Detection of genetic diversity of tea (*Camellia sinensis* L.) using RAPD markers. Genome, 38: 201-210.