Research Article

Ekin
Journal of Crop Breeding and Genetics

5(1):32-41, 2019

www.ekinjournal.com

Ekin International biannual peer-reviewed journal

Effect of Application of Increasing Nitrogen Rates on Tillering Characters of Triticale (x*Triticosecale* Wittmack) Genotypes

Nurcan AKAY GURBUZ[1] **Emel OZER**[2*] **Nurdilek GULMEZOGLU**[3]

[1] Ministry of Agriculture And Forestry, Mezitli, Mersin

[2] Bahri Dagdas International Agricultural Research Institue Konya, Turkey

[3] Eskisehir Osmangazi University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, Eskisehir, Turkey

[*] Corresponding author e-mail: emel4272@yahoo.com

Citation:
Gurbuz N. A., Ozer E., Gulmezoglu N., 2019. Effect of Application of Increasing Nitrogen Rates on Tillering Characters of Triticale (x*Triticosecale* Wittmack) Genotypes. Ekin J. 5(1): 32-41, 2019.

Received : 13.10.2018 ***Accepted : 16.11.2018*** ***Published Online : 28.01.2019*** ***Printed : 29.01.2019***

ABSTRACT

Grain yield of wheat depends on plants per area, tiller per plant, kernels per spike, and weight per kernel. However only some tillers produce grain; other fail to develop a spike and die before the main stem matures and this is related to genetic factors and other environmental conditions. This research is aimed to determination of effect on different nitrogen applications to ear characters and kernel protein contents of tillers by using six different triticale genotypes (Tatlıcak 97, Melez-2001, MIKHAM-2002, Karma 2000, Samur Sorti, Presto 2000). In this experiment, differences for tillers were observed in triticale genotypes where nitrogen doses were applied during growing period of the year 2006/2007. Considering the effects of nitrogen doses for tillers, while importance of the length of ear is 5%, kernels in ear, weight of kernel, the number of ear was found 1% important. When characterization of kernel examined, 80 kg nitrogen ha^{-1} application on yield and thickness of kernel and protein content was found important by 1%, but the same application on width, length and thousand weight of kernel was found unimportant.

Keywords: ear, nitrogen, protein, spike, tillering, triticale

Introduction

Rapid population growth and drought have made it compulsory to obtain abundant and quality crops in order to feed the world's population adequately (Anonymous 2018). Scientists are also working on cereals, which are the most planted and produced plant group in the world to serve this purpose. With the increase in population, the inadequacy of agricultural areas has led to the need to develop plants that will lead to high yields from the difficult conditions of crops production. In particular, the development of biology, the effective use of genetic and plant regeneration methods have enabled good results to be obtained from these studies. One of the most successful products obtained from these studies was triticale (Anonymous 2017).

The plants need nitrogen at every stage of their development. There are two growing periods in the uptake of nitrogen from cereals, one of tillering stage and the other for spike formation stage (Alzueta et al. 2012; Wang et al. 2017). Tillering is an important feature in terms of grains and is particularly useful for compensating properties when faced with bad conditions (such as anomalies in emergence, winter or frost damage) (Dreccer et al. 2013). Since the bud plant, which will be formed by the first tiller, is formed with three leaves, in order to be supported from the beginning of the tillering, the nitrogen must be present in this period when it can be taken by the plant. If there is nitrogen deficiency during the formation of the 4th and 5th leaves on the main stem of the plant, it will be too late to support the formation of the first two tillers even after application of nitrogen after 6th leaf formation. In such a case, even if the third tiller is formed, the first and second tillers with high efficiency potency may disappear. On the contrary, if there is nitrogen deficiency after the formation of the first 2nd or 3th of tillers, the plant may consist only of the main stem and these tillers, even if water and other environmental conditions are more favourable for tillering may remain ineffective (Reichenberger 2006). This research is aimed to determine the effects of increasing variations in nitrogen doses, triticale genotypes and lines on the tillering traits and the characteristics of spike and grain, which determine the yield potential depending on the environmental conditions, and to determine the effects of the differences between the varieties and the tillers on the yield.

Materials and Methods

Experimental Site and Soil Properties

The research was carried out in the research field of the Eskisehir Osmangazi University Faculty of Agriculture in the center of Eskisehir in 2006/2007 year. The results of soil analysis taken from 0-30 cm depth to determine the physical and chemical properties of the study site are given in Table 1. Soil had low organic matter, alkaline and moderate lime. The available phosphorus and potassium were inadequate and adequate, respectively. The soils contained insufficient Zn, Mn (10.3 mg kg^{-1}) and sufficient Cu (1.27 mg kg^{-1}) but high Fe (4.55 mg kg^{-1}) concentrations. The soil texture was loam and the soils had low in total nitrogen supply to plants.

Climate Data and Experimental design

The average annual precipitation and temperature (from October to July) is 347 mm and 9.1°C for the area over the last 60 year, 301 mm and 9.2°C for 2006/07. In both years, the total precipitation was less than the average of many years (346.9 mm). The average temperature was higher in the second year (9.2°C) than in the first year (8.5°C). The average relative humidity was close to each other in both years.

The five triticale varieties (Tatlıcak-97, Karma 2000, Melez-2001, MIKHAM-2002 and Presto) which are registered as winter triticale varieties in Turkey, an Azerbaijan variety (Samur sortu) and five lines obtained from CIMMYT was used in the study. Characteristics of triticale genotypes in the experiment are given in Table 2.

The 11 hexaploid winter triticale genotypes were provided from Bahri Dagdas International Agricultural Research. The sowing was done in October (10th in 2006). Each plot (7.5 m^2) was six rows and the space between the row s was 25 cm. The seeds were planted with 450 seed m^{-2}. The 60 kg P_2O_5 ha^{-1} as triple superphosphate was applied to all plots. The experimental design was a split-plot design with four replicates. The main plots consisted of four nitrogen levels and the subplots consisted of triticale genotypes. Control plots received no nitrogen (0kg), while nitrogen fertilized plots were treated with 40, 80 and 160 kg nitrogen ha^{-1}. It was applied one-half of nitrogen fertilizer at planting as ammonium sulphate (26% N) and the rest of nitrogen was applied as topdressing at tillering time using ammonium nitrate (33% N). The plants were harvested in July (9th in 2007).

Sampling, measurements and statistical analysis

At harvest time, when the plants were completely dried, they were cut from aboveground in the middle of each plot (3 m x 1 m). The characters of spike length (cm), spikelet number per spike, number of grains per spike, spike weight (g) and protein (%) were determined on 25 randomly selected plants from each plot for each tillers. Protein content of grain was converted from total nitrogen determined using by the Kjeldahl digestion method.

The data were analysed by using MSTAT-C (MSTAT, 1984) the statistical package. The differences between the treatment means were compared by least significant differences (LSD) test.

Results and Discussion

Spike length (cm)

Spike length is important in terms of forming the number of spikelet's in the spike, being highly influenced by environmental conditions. Nitrogen application was found significant ($P<0.01$), for its effect on spike length of tillers and there were differences among genotypes (Table 3). When the averages of spike length of the triticale genotypes were examined; nitrogen application did not increase the spike length.

The control had the highest spike length (9.66 cm) but the lowest spike length (9.18 cm) was at 80 kg N ha^{-1}. The highest spike length of the first tiller was

TVD-9 line (11.43 cm at 80 kg N ha^{-1}) and Samur Sortu genotype (10.35 cm) had the highest spike length at second tiller. The mean spike lengths of the first and second tiller were 9.67 and 9.20 cm, respectively. Spike length differed according to genotypes and nitrogen rates.

Increased nitrogen doses did not increase the spike length of the triticale genotypes and increased the spike length of the first tiller by 4.80% compared to the second tiller. Şekeroğlu (1997) and Gülmezoglu (2003) stated that spike length is between 5.96-6.48 cm and 11.71-11.82 cm respectively, and that with increasing nitrogen doses, triticale increases spike lengths.

Spikelet Number Per Spike

When the variance analysis of spikelet number are examined, the nitrogen was found to be nonsignificant, while the genotype, N x G interaction, tiller, N x T interactions, G x T interactions and N x G x T interaction were found to be significant (Table 4). Nitrogen rates were effective in decreasing the number of spikelet until the application of 40 kg N ha^{-1} in spikelet number per spike of tillers, while it increased at 80 kg N ha^{-1} rate. The highest spikelet number of the first tiller was obtained between 23.95 at 80 kg N ha^{-1} dose, 22.15 at the lowest 40 kg N ha^{-1} dose. The second tiller had the highest spikelet number in control with 21.10, the lowest number of spikes in 20.46 and 80 kg N ha^{-1}.

The highest spikelet number for the first tiller was found on the TVD-9 (28.63 at 80 kg N ha^{-1}) and the lowest number of spikelet at 80 kg N ha^{-1} in the TVD-25 line (19.60 units). The highest spikelet number for the second tiller was obtained from 160 kg N ha^{-1} in the TVD-9 line (24.54 units) and from 80 kg N ha^{-1} in the TVD-4 line (17 units) with the lowest number of spikelet. Spikelet number is a significant character on yield because it can affect grain number. Increasing nitrogen rates did not increase the number of spikelet in triticale genotypes but increasing the number of spikelet in the first tiller 9.35% compared to the second tiller. In the study performed in the triticale genotypes, the number of spike per spikelet changed between 14-27.2 units (Gill, et al. 1990).

Grain numbers of per spike

According to variance analysis (Table 5), nitrogen application, G, T, N x G, N x T, G x T and N x G x T interactions were found significant ($P<0.01$) on grain number per spike. When the average grain number per spike was examined, the highest grain number per spike was 45.28 from the first tiller in control and the lowest grain number per spike was 27.85 from the second tiller (Table 5). The highest and lowest grain numbers per spike in genotypes were TVD-9 (56.63) from the first tiller at 80 kg N ha^{-1} and Melez-2001 (33.15) at 160 kg N ha^{-1}. In the second tiller, TVD-4 had the highest grain (57.17) at 40 kg N ha^{-1} and Presto had the lowest grain (27.85) at 160 kg N ha^{-1}. Also, grain number per spike of the first tiller (43.45) had higher number of grains than that of second tiller (38.22). A large grain number per spike positively affected both yield and quality of grain. (Yanbeyi, 1997; Khaliq et al. 2004).

Spike weight

It was found that N, G, T, N x G, T, N x T, G x T and N x G x T interactions of single spike yields (Table 6) were significant ($P<0.01$). Spike weight of plants was the highest in control (1.62 g). Increasing nitrogen doses had been found to reduce the yield of single spikes. The highest single spike weight of first tiller was obtained from TVD-4 line (2.55 g) at 40 kg N ha^{-1}, while the lowest single spike yield was obtained from second tiller at 40 kg N ha^{-1} (0.81 g) from Tatlıcak 97. Spike weight is dependent on spike length, grain number per spike and the grain size and is greatly influenced by environmental conditions and cultivation techniques.

The effect of increasing nitrogen doses on spike yield was negative and the highest from single spike was obtained from the control dose. The single spike yield changed between 2.2 and 2.4 g, application of 120 kg ha^{-1} nitrogen dose to triticale is reported the highest spike weight (Üstünalp 2010).

Total Protein Content

Nitrogen application was found to be significant at 5% level and G, T, N x G, N x T, G x T and N x G x T interactions were found to be significant at 1% level (Table 7). When the average nitrogen effects on the protein of the triticale genotypes was examined, the highest protein value (14.10 %) was found at 160 kg N ha^{-1}. The highest and lowest protein values of genotypes were Samur sortu from first tiller at 40 kg ha^{-1} (17.60 %) and Presto from second tiller at 80 kg ha^{-1} (10.40 %), respectively. Protein content increased with increasing nitrogen rate. Protein is a lifelong necessity for both human and animal nutrition.

Nitrogen doses applied caused a change of 4.36% among the tillers in protein content. In both tillers, the highest protein content was reached in the control dose. It has been explained that the protein content of bread wheat and its environmental factors change irregularly in all locations, and the variation in protein ratio is lower than the effect of environmental factors (Rao, et al. 1993).

Conclusion

In this study, the effect of nitrogen dose applied on the effects of spike properties on nitrogen dosing among the first and second tillers of triticale; however, it was determined that the newly developing tillers had lower spike, grain and protein values than the first tiller. Generally, the highest values are obtained from the control application. Genotypes revealed genotypic differences according to nitrogen doses. The results of the study show that the new developing tiller has lower spike, grain and protein values than the first tiller.

Nitrogen rates were significant effect on all spike characteristics without spikelet number. There were significant differences on spike characters on protein between tillers. First tiller had higher value than second tiller in all investigated characters. The highest spike length, spikelet number and grain number of spike in first tillers were obtained from TVD-9 line at the rate of 80 kg N ha^{-1}. Grain yield was highest in TVD-25 line at 80 kg N ha^{-1}.

Table 1. Physical and chemical properties of the soil.

					Available for plants		
Texture	**pH**	**Total Salt (%)**	**Organiz Matter (%)**	**$CaCO_3$ (%)**	**Phosphate (P_2O_5) (kg ha^{-1})**	**Potassium (K_2O) (kg ha^{-1})**	**Zinc (Zn) (mg kg^{-1})**
Loam	7.8	0.087	1.27	5.14	20	190.7	0.60

Table 2. Triticale varieties and pedigri of lines.

Varieties	**Variety authority, registration year and pedigree**
Tatlıcak 97	BDIARI/Konya
Presto	TZARI/Eskisehir
Karma-2000	TZARI/Eskisehir
Melez-2001	BDIARI/Konya
MİKHAM-2002	BDIARI/Konya
Samur Sortu	Azerbaijan Variety
TVD-3	CHD 333 85/VICUNA_4 CTWS92Y2-10FM-1FM-1FM-0FM
TVD-4	CT1731.81/ARMINO_4 CTWS92Y6-2FM-1FM-2FM-0FM
TVD-9	EMS M83.6039/CT583.81//PRESTO CTWW92WM00010S-4WM-1WM-1WM-1WMR-0WM
TVD-17	ERIZO_10*BULL_1-1//SONNI_4-2 CTSS93B00204S-2M-0Y-0Y-0B
TVD-25	STIER_29/FARAS_1//2*JIL96 CTSS93B00617M-C-3Y-0M-0Y-0B-3Y-OB

Table 3. Mean values of triticale genotypes in spike length (cm) at different nitrogen doses.

Tiller	Genotypes	Nitrogen rates (kg ha^{-1})				Mean
		0	40	80	160	
First Tiller	TVD- 3	9,13 n-aa	9,46 f-v	9,15 m-aa	8,78 u-ab	9,1
	TVD- 4	9,40 g-v	9,36 h-w	8,81 u-ab	8,17 ab-ac	8,9
	TVD- 9	10,37 b-f	9,55 v	11,43 a	11,15 a-b	10,6
	TVD- 17	10,09 c-m	8,78 u-ab	8,85 t-ab	9,56 e-v	9,3
	TVD- 25	9,45 f-v	8,93 r-ab	8,38 y-ac	9,11 n-ab	9,0
	Tatlıcak 97	9,43 f-v	9,60 e-v	8,22 aa-ac	9,88 d-r	9,3
	Melez- 2001	10,17 c-k	11,02 a-c	10,29 b-h	9,93 d-p	10,4
	MİKHAM-2002	9,94 d-p	10,06 d-n	9,52 g-v	9,88 d-r	9,9
	Karma 2000	10,06 d-o	9,78 d-t	10,35 b-g	10,25 b-i	10,1
	Samur Sortu	10,21 b-j	10,48 a-e	10,69 a-d	11,36 a	10,7
	Presto- 2000	9,68 e-u	9,78 d-t	8,42 w-ac	8,95 q-ab	9,2
Second Tiller	TVD- 3	9,47 f-v	9,35 h-w	8,65 v-ab	8,73 u-ab	9,1
	TVD- 4	9,97 d-p	9,19 l-z	6,57 a-d	7,69-a-c	8,4
	TVD- 9	9,98 d-p	9,29 j-z	9,07 p-ab	10,00 d-p	9,6
	TVD- 17	8,95 q-ab	8,67 v-ab	8,15-ab-ac	8,65 v-ab	8,6
	TVD- 25	9,42 f-v	9,10 o-ab	8,36 z-ac	8,95 q-ab	9,0
	Tatlıcak 97	9,32 i-z	9,25 k-z	8,87 s-ab	8,73 u-ab	9,0
	Melez- 2001	9,83 d-s	9,88 d-r	10,12 c-l	9,91 d-q	9,9
	MİKHAM- 2002	8,89 s-ab	9,23 k-z	8,97 q-ab	9,30 i-z	9,1
	Karma 2000	9,64 e-u	9,51 g-v	9,25 k-z	9,33 i-y	9,4
	Samur Sortu	9,55 e-v	10,14 c-l	10,35 b-g	10,30 b-h	10,1
	Presto- 2000	9,60 e-v	9,60 e-v	9,52 g-v	7,68 a-d	9,1
Mean	Nitrogen	9,66	9,55	9,18	9,37	
	Tillers	First Tiller: 9,68		Second Tiller: 9,20		
	Genotypes&	9,09 8,64 10,10 8,96 8,96 9,16 10,14 9,47 9,77 10,38 9,15				
LSD	P<0.01**	N: 0,205 G: 0,339 T: 0,144 G x N: 0,678 G x K: 0,479 G x N x T: 0.958				
	P<0.05*	N x T: 0.219				

N: Nitrogen, G: Genotype, T: Tiller**1% significant; *5% significant; &: The averages are given side by side in accordance with the order of the above genotypes.

Table 4. Mean values of triticale genotypes in spikelet number per spike (piece) at different nitrogen doses.

Tiller	Genotypes	Nitrogen rates (kg ha^{-1})				Mean
		0	40	80	160	
First Tiller	TVD- 3	21,94 e-s	22,25 e-q	21,25 h-v	21,17 h-w	21,7
	TVD- 4	22,45 d-p	23,59 d-ı	21,84 f-s	22,38 d-p	22,6
	TVD- 9	23,63 d-h	23,40 d-j	28,63 a	27,05 a-c	25,7
	TVD- 17	23,59 d-ı	22,40 d-p	23,00 d-m	24,54 c-e	23,4
	TVD- 25	22,88 d-m	21,35 g-v	19,60 t-aa	21,88 f-s	21,4
	Tatlıcak 97	20,50 m-y	20,25 n-z	20,00 p-z	22,46 d-p	20,8
	Melez-2001	21,45 g-u	22,46 d-p	22,81 d-n	19,95 p-z	21,7
	MİKHAM- 2002	21,38 g-u	22,67 d-o	27,90 a	23,30 d-k	23,8
	Karma 2000	23,15 d-l	20,56 l-y	28,55 a	24,95 b-d	24,3
	Samur Sortu	22,06 e	22,13 e-r	22,38 d-p	23,88 d-g	22,6
	Presto- 2000	24,08 d-f	22,63 d-o	27,44 a-b	23,35 d-k	24,4
Second Tiller	TVD- 3	21,56 f-t	22,31 e-p	18,50 x-aa	20,75 k-x	20,8
	TVD- 4	22,13 e-r	23,42 d-j	17,00 aa	19,42 s-aa	20,5
	TVD- 9	22,38 p	21,75 f-s	20,58 l-y	24,54 c-e	22,3
	TVD 17	19,88 p-z	21,45 g-u	21,15 h-w	22,63 d-o	21,3
	TVD- 25	22,25 e-q	21,75 f-s	19,00 t-aa	20,05 o-z	20,8
	Tatlıcak 97	22,42 d-p	18,40 x-aa	18,13 y-aa	19,00 t-aa	19,5
	Melez-2001	20,44 m-y	18,90 u-aa	22,35 d-p	20,50 m-y	20,5
	MİKHAM- 2002	17,81 z-aa	18,60 w-aa	21,38 g-u	21,00 ı-x	19,7
	Karma 2000	22,15 e-r	20,81 j-x	23,13 d-l	20,90 j-x	21,7
	Samur Sortu	18,75 v-aa	19,64 q-z	21,95 e-s	20,60 l-y	20,2
	Presto- 2000	22,25 e-s	22,44 d-p	21,94 e-s	18,85 u-aa	21,4
Mean	Nitrogen	21,78	21,51	22,20	21,96	
	Tillers	First Tiller: 22,93		Second Tiller: 20,79		
	Genotypes&	21,22 21,53 23,99 22,33 21,10 20,14 21,11 21,75 23,02 21,42 22,87				
LSD	P<0.01**	N: 1,093 G: 0,927 T: 0,395		G x N: 1,854 G x T: 1,311 N x T: 0,790 G x N x T: 2,622		

N: Nitrogen, G: Genotype, T: Tiller ** 1% significant; * 5% significant; &: The averages are given side by side in accordance with the order of the above genotypes.

Table 5. Mean values of triticale genotypes in grain number per spike (piece) at different nitrogen doses.

Tiller	Genotypes	Nitrogen rates (kg ha^{-1})				Mean
		0	40	80	160	
First Tiller	TVD- 3	45,31 e-k	42,25 ı-p	43,56 g-n	36,88 u-ac	42,0
	TVD- 4	47,65 c-g	45,92 d-j	49,75 b-d	42,25 ı-p	46,4
	TVD- 9	45,44 d-k	40,65 l-v	56,63 a	47,25 c-g	47,5
	TVD- 17	47,83 c-g	46,55 d-ı	39,88 m-w	48,54 c-f	45,7
	TVD- 25	41,42 k-s	47,90 c-g	38,95 o-y	37,71 r-z	41,5
	Tatlıcak 97	40,56 l-v	37,88 q-z	33,75 z-ah	43,96 g-m	39,0
	Melez-2001	42,80 h-o	42,71 ı-o	40,67 l-v	33,15 aa-ah	39,8
	MİKHAM- 2002	45,94 d-j	41,25 k-t	49,50 b-e-l	39,55 n-x	44,1
	Karma 2000	53,65 a-b	40,25 m-w	46,55 d-ı	47,35 c-g	47,0
	Samur Sortu	41,50 k-s	46,31 d-j	37,81 r-z	44,88 f	42,6
	Presto- 2000	46,00 d-j	44,13 g-m	42,19 j-q	37,00 t-ab	42,3
Second Tiller	TVD- 3	47,19 c-g	40,19 m-w	35,50 x-af	35,25 x-ag	39,5
	TVD- 4	47,63 c-g	57,17 a	32,59 ac-ah	35,38 x-af	43,2
	TVD- 9	51,13 b-c	40,00 m-w	35,50 x-af	37,59 s-z	41,1
	TVD- 17	37,94 p-z	38,95 o-y	36,15 w-ae	41,42 k-s	38,6
	TVD- 25	41,38 k-s	42,05 j-r	30,13 ah-aı	33,75 z-ah	36,8
	Tatlıcak 97	40,25 m-w	31,00 ag-aı	31,94 ae-aı	31,63 af-aı	33,7
	Melez -2001	42,63 ı-o	35,95 w-af	38,9540 o-y	41,96 j-r	39,9
	MİKHAM- 2002	36,50 v-ad	32,40 ad-ah	35,19 y-ag	32,05 ae-aı	34,0
	Karma 2000	47,10 c-h	35,00 y-ag	41,38 k-s	35,45 x-af	39,7
	Samur Sortu	37,19 s-aa	32,74 ab-ah	35,25 x-ag	31,85 ae-aı	34,3
	Presto- 2000	47,13 c-h	42,56 ı-o	40,94 l-u	27,85 aı	39,6
Mean	Nitrogen	44,28	41,08	39,67	38,30	
	Tillers	First Tiller: 43,45		Second Tiller: 38,22		
	Genotypes[&]	40,77 44,79 44,27 42,16 39,16 36,37 39,85 39,05 43,34 38,44 40,97				
LSD	P<0.01**	N: 1,164 G: 1,541- T: 0,657		G x N: 3,082 G x T: 1,649 N x T: 1,314 G x N x T: 4,359		

N: Nitrogen, G: Genotype, T: Tiller ** 1% significant; * 5% significant; [&]: The averages are given side by side in accordance with the order of the above genotypes.

Table 6. Mean values of triticale genotypes in spike weight (g) at different nitrogen doses

Tiller	Genotypes	Nitrogen rates (kg ha^{-1})				Mean
		0	40	80	160	
First Tiller	TVD- 3	2,05 d-e	1,43 t-z	1,50 q-x	1,33 y-af	1,58
	TVD- 4	1,87 f-g	2,55 a-b	2,27 b-c	1,61 m-r	2,08
	TVD- 9	1,56 o-u	1,55 o-u	2,21 c-d	1,69 h-o	1,75
	TVD -17	1,88 f-g	1,53 p-v	1,36 x-ac	1,56 o-u	1,58
	TVD- 25	1,58 n-t	1,84 f-h	1,62 l-q	1,59 n-s	1,66
	Tatlıcak 97	1,35 y-ad	1,17 ag-ak	1,09 aı-am	1,47 r-y	1,27
	Melez-2001	1,75 g-m	1,68 ı-p	1,66 j-p	1,17 ag-ak	1,57
	MİKHAM-2002	1,87 f-g	1,77 g-k	1,70 h-o	1,25 ab-ah	1,65
	Karma 2000	1,96 e-f	1,56 o-u	1,77 g-k	1,69 h-o	1,75
	Samur Sortu	1,76 g-l	1,56 o-u	1,51 q-w	1,82 f-ı	1,66
	Presto- 2000	1,45 t-z	1,52 q-w	1,70 h-o	1,39 v-ab	1,52
Second Tiller	TVD- 3	1,62 m-r	1,43 t-z	1,33 y-af	1,19 af-ak	1,39
	TVD -4	1,80 g-j	2,66 a	1,19 ae-aj	1,28 aa-ag	1,73
	TVD -9	1,54 p-u	1,45 s-y	1,05 ak-an	1,08 aj-am	1,28
	TVD -17	1,47 r-y	1,26 ab-ah	1,11 ah-al	1,31 z-ag	1,29
	TVD -25	1,56 o-u	1,65 k-q	1,19 af-ak	1,44 t-z	1,46
	Tatlıcak 97	1,25 ab-ah	0,81 ap	0,86 ao-ap	0,97 al-ao	0,97
	Melez -2001	1,72 h-n	1,36 x-ac	1,52 p-w	1,64 k-q	1,56
	MİKHAM- 2002	0,96 am-ao	1,34 y-ae	0,91 an-ap	0,88 ao-ap	1,02
	Karma 2000	1,64 k-q	1,23 ac-aı	1,20 ad-aj	1,24 ab-ah	1,33
	Samur Sortu	1,71 h-n	1,27 aa-ag	1,38 w-ab	1,24 ab-ah	1,40
	Presto -2000	1,42 u-aa	1,75 g-m	1,86 f-g	0,89 ao-ap	1,48
Mean	Nitrogen	1,62	1,56	1,45	1,35	
	Tillers	First Tiller: 1,64		Second Tiller: 1,35		
	Genotypes[&]	1,48 1,90 1,52 1,43 1,56 1,12 1,56 1,33 1,53 1,53 1,50				
LSD	P<0.01**	N: 0,055 G: 0,052 T: 0,022		G x N: 0,105 G x T: 0,074 N x T: 0,045 G x N x T: 0,148		

N: Nitrogen, G: Genotype, T: Tiller ** 1% significant; * 5% significant; [&]: The averages are given side by side in accordance with the order of the above genotypes.

Table 7. Mean values of triticale genotypes in total protein (%) at different nitrogen doses.

Tiller	Genotypes	Nitrogen rates (kg ha^{-1}) 0	40	80	160	Mean
First Tiller	TVD- 3	13,99 e-q	13,96 e-q	13,63 g-s	15,05 c-ı	14,16
	TVD -4	13,99 e-q	13,23 j-u	12,78 n-w	14,69 c-k	13,67
	TVD- 9	13,47 h-u	13,94 f-q	12,13 s-x	14,85 c-j	13,60
	TVD -17	13,05 k-v	14,11 d-p	13,24 j-u	15,16 c-h	13,89
	TVD -25	13,23 j-u	13,11 k-v	13,61 g-s	15,51 b-f	13,87
	Tatlıcak 97	13,60 g-s	14,54 d-m	13,90 f-r	14,39 d-o	14,11
	Melez-2001	16,38 a-c	13,79 f-s	15,77 b-d	14,02 e-q	14,99
	MİKHAM-2002	13,09 k-v	14,36 d-o	13,73 g-s	14,98 c-ı	14,04
	Karma 2000	14,29 d-p	12,21 r-w	12,73 o-w	14,49 d-n	13,43
	Samur Sortu	14,59 d-l	17,60 a	14,59 d-l	15,16 c-h	15,49
	Presto -2000	14,62 d-l	13,12 k-v	13,65 g-s	14,68 c-k	14,02
Second Tiller	TVD- 3	13,72 g-s	14,34 d-p	14,73 c-k	11,45 v-x	13,56
	TVD- 4	14,67 c-k	13,47 h-u	12,09 s-x	11,83 t-x	13,02
	TVD- 9	13,72 g-s	13,54 h-t	12,77 n-w	12,94 l-v	13,24
	TVD -17	13,05 k-v	14,12 d-p	15,07 c-ı	13,98 e-q	14,06
	TVD -25	13,95 f-q	13,04 k	14,16 d-p	14,42 d-o	13,89
	Tatlıcak 97	11,75 u-x	11,09 w-x	12,31 q-w	13,39 ı-u	12,14
	Melez-2001	15,68 b-e	14,14 d-p	12,62 p-w	13,51 h-t	13,99
	MİKHAM-2002	13,04 k-v	14,66 c-l	13,00 k-v	13,70 g-s	13,60
	Karma 2000	14,45 d-o	11,86 t-x	11,46 v-x	13,80 f-s	12,89
	Samur Sortu	14,68 c-k	16,94 a-b	14,95 c-j	15,27 b-g	15,46
	Presto-2000	13,55 g-t	13,72 g-s	10,47 x	12,83 m-v	12,64
Mean	Nitrogen	13,94	13,86	13,34	14,10	
	Tillers	First Tiller: 14,11		Second Tiller: 13,50		
	Genotypes[&]	13,86 13,34 13,42 13,97 13,88 13,12 14,49 13,82 13,16 15,47 13,33				
LSD	P<0.01**	G: 0,611 T: 0,260 G x N: 1,222		G x T: 0,864 N x T: 0,521 G x N x T: 1,728		
	P<0.05	N: 0,429				

N: Nitrogen, G: Genotype, T: Tiller ** 1% significant; * 5% significant; [&]: The averages are given side by side in accordance with the order of the above genotypes.

References

Alzueta I, Abeledo LG, Mignone CM and Miralles DJ (2012) Differences between wheat and barley in leaf and tillering coordination under contrasting nitrogen and sulphur conditions. Eur J Agron 41(1):92–102.

Anonymous 2017. The Growth Potential of Triticale in Western Canada: Section B - Genetic Basis, Breeding and Varietal Performance of Triticale. https://www1.agric.gov. ab.ca/$department/deptdocs.nsf/all/fcd4232.

Anonymous 2018. How to Feed the World in 2050. http://www.fao.org/fileadmin/ templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

Dreccer F, Chapman SC, Rattey A, Neal J, Song Y, Christopher JT and Reynolds M (2013). Developmental and growth controls of tillering and water-soluble carbohydrate accumulation in contrasting wheat (*Triticum aestivum* L.) genotypes: can we dissect them? J. Exp. Bot. 64, pp: 143-160.

Gill KS, Sandha GS and Dhinosa GS (1990). Germplasm evaluation and utilization in spring triticale, Proceedings of the Second International Triticale Symposium, 30-31.

Gülmezoğlu N (2003). Eskişehir kuru koşullarında değişik azotlu gübrelerin, kışlık tritikalelerin çıkış, başaklanma, çiçeklenme ve olum süreleri ile verim öğeleri ve bazı kalite özellikleri üzerine etkileri, Osmangazi Ü. Fen Bilimleri Enstitüsü, Doktora Tezi, Eskişehir, 160s (In Turkish).

Khaliq I, Parveen N and Chowdhry MA (2004). Correlation and path coefficient analysis in bread wheat. Int. J. Agric. Biol., 4:633-635.

MSTAT (1984) MSTAT-C Microcomputer Statistical Program. Michigan State University. East Lansing, MI, USA.

Rao ACS, Smith JL, Jandhyala VK, Papendick RI and Parr JF (1993). Cultivar and climatic effects on the protein content of soft white winter wheat, Argon. J., 85: 1023-1028.Reichenberger L. 2006. Tie nitrogen to tillering. http://www.needhamag.com/documents/ Tie_ Nitrogen_To_Tillering.pdf.

Şekeroglu N (1997). Van ekolojik şartlarında bazı yazlık triticale hatlarının verim ve verim unsurları üzerine farklı dozlarda azotlu gübrelemenin etkisi, Yüzüncü Yıl Ü. Fen Bilimleri Enstitüsü Yüksek Lisans Tezi, 45-51 (In Turkish).

Üstünalp G (2010). Değişik ekim sıklıkları ve azot dozlarının tritikalede (x *Triticosecale Wittmack*) verim ve verim öğeleri üzerine etkileri. Namık Kemal Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 52 sayfa.

Wang Y, J Lu, T Ren, S Hussain, C Guo, S Wang, R Cong and X Li (2017). Effects of nitrogen and tiller type on grain yield and physiological responses in rice. AoB Plants 9 (2):plx012. doi:10.1093/aobpla/plx012.

Yanbeyi S (1997). Samsun ekolojik koşullarında bazı tritikale çeşit ve hatlarının verim ve verim öğeleri üzerine bir araştırma, Ondokuz Mayıs Ü. Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 48 s.