Research Article

Ekin
Journal of Crop Breeding and Genetics

5(1):24-31, 2019

www.ekinjournal.com

Ekin International biannual peer-reviewed journal

Assessing of the Some Feeding Quality Characteristics of Triticale in Comparison with Other Winter Cereals

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Citation:

Korkut Z. K., Balkan A., Ozduven L., Bilgin O., Baser I., 2019. Assessing of The Some Feeding Quality Characteristics of Triticale in Comparison With Other Winter Cereals. Ekin J. 5(1): 24-31, 2019.

Received : 15.08.2018 ***Accepted : 15.10.2018*** ***Published Online : 28.01.2019*** ***Printed : 29.01.2019***

ABSTRACT

The study was carried out with 20 winter cereal genotypes including 3 triticale, 2 rye, 3 bread and 3 durum wheat, 3 two-rowed and 3 six-rowed barley and 3 oat in two different locations (Tekirdağ and Luleburgaz) in 2015-2016 growing years. Protein content, fat content, moisture content, ash content, cellulose, starch, NDF, ADF and ADL properties were investigated in the sample obtained from whole plant parts. It was determined that protein content ranged between 11.2-11.8% for rye, 12.4-13.6% for bread wheat, 13.9-15.4% for durum wheat, 12.4-15.5% for barley, 10.0-13.2% for oat and 13.3-14.8% for triticale. The fat ratio ranged from 1.5-1.7% for rye, 1.4-1.5% for bread wheat, 1.6-1.7% for durum wheat, 1.6-1.8% for barley, 1.1-1.6% for oats and 1.5-1.5% for triticale. The ash content was found to be 1.6-1.7% for rye, 1.4-1.5% for bread wheat, 1.5% for durum wheat, 2.0-2.6% for barley, 1.5-2.1% for oats and 1.6% for triticale. The cellulose ratios ranged between 2.7-2.9% for rye, 2.5-2.7% for bread wheat, 2.6-2.8% for durum wheat, 4.6-5.1% for barley, 10.0-13.2% for oats and 4.5-8.4% in triticale. The starch ratios for rye, bread wheat, durum wheat, barley, oat and triticale ranged from 57.7-59.1%, 58.7-59.9%, 57.0-59.0%, 48.3-51.1%, 42.0-50.3% and 57.2-58.6%, respectively. NDF ratios were calculated at intervals 13.61-15.85% for rye, 15.70-23.56% for bread wheat, 18.56-20.50% for durum wheat, 19.56-30.64% for barley, 20.25-22.61% for oat and 13.87-18.80% for triticale. ADF ratios ranged between 3.77-5.61% for rye, 4.78-7.88% for bread wheat, 4.02-5.38% for durum wheat, 5.56-9.48% for barley, 5.56-6.75% for oat and 5.1-5.55% for triticale. ADL ratios of the varieties investigated ranged from 1.62-2.47% for rye, 1.61-2.85% for bread wheat, 0.83-2.25% for durum wheat, 0.96-1.99% for barley, 0.96-1.79% for oat and 1.27-1.50% for triticale.

Keywords: triticale, protein ratio, fat content, ash content, cellulose, starch, NDF, ADF

Introduction

The name Triticale was first introduced in a literature published in Germany in 1935. It is believed that the Triticale work began with wheat/rye hybrids in Scotland in 1875. While the first hybrids obtained from these studies were sterile (Stallknecht et al. 1996), the first fertile hybrid plants were obtained by the German breeder Rimpau (McGoverin et al. 2011). In this way, it is aimed to combine the grain quality characteristics of wheat with the tolerance and/or resistance characteristics of rye to biotic and abiotic stress conditions. Worldwide wheat x rye hybridization studies have been started

in countries like Russia, Sweden, Switzerland, Hungary, Germany, Spain and Canada since 1930's and then the first commercial triticale variety was registered in 1968 in Hungary. Now a days, winter, summer and alternative type of triticale varieties have been improved. Germany, Poland, Canada, China, Australia, France, and Mexico are the most triticale producer worldwide (Ammar et al. 2004). Triticale (× *Triticosecale Wittmack*), a cross of wheat and rye and known as the first man-made cereal, is more tolerant of biotic and abiotic stress conditions than wheat. It is therefore a more suitable plant for marginal areas (Villegas et al. 2010). Triticale has high yield, broad adaptability and high nutrient content compared to other cool season cereals, (Oettler, 2005). Especially, the importance of triticale as an alternative plant is increasing day by day for areas that are not suitable for wheat production, where the depth of the soil is low, the barren and the winters are very hard, and for the closing of the increased feed shortage. The first studies on triticale in our country were initiated by Osman Tosun in the 1940's and continued with the researches made by Ibrahim Demir on summer varieties in the 1970's (Demir et al. 1986). The first registered triticale variety for our producers was Tatlıcak 97 (Kınacı and Kınacı, 2000).

Due to its plant characteristics, triticale has a long plant height, but it is very resistant to laying due to its sturdy handle property. Triticale, which has more green plant parts than wheat, comes to harvest earlier than wheat. The development of varieties of triticale, which can be grown especially in fields that are not suitable for wheat and barley production, are priority breeding purposes. It is also among the other breeding purposes that livestock can be fed and be regarded as a food source for humans. It has been determined that triticale genotypes give better results in inefficient soil area, on suitable soil for agriculture and sloping areas as well as in productive areas due to their yield and quality characteristics compared to other cool climate cereals (Korkut et al. 2007; Korkut et al. 2009, Duğan, 2010).

In recent years, abiotic and biotic stress factors have caused significant loss of crop production. In order to reduce these losses, excessive agrochemical use is being carried out in some regions, especially in the region of Thrace. This causes increase in costs and changes in ecological structure. It has been shown that triticale can easily be grown in diseases, harmful, drought, acidic and troubled soil, and is an alternative to feed plants (Furan et al. 2005). Triticale has taken its potential to adapt to marginal areas and yield potential for pasta. On the other hand, the ability to grow in cold, acidic, saline soils is taken from the rye (Turan, 2008).

Feeding pea and vetch are the most preferred species in meeting the need of dry weed in animal production in Marmara region. When these plants are harvested during full bloom period, weeds contain about 20% crude protein. It is common practice to cultivate these plants by mixing them with an appropriate grain in the production of hay. A mixture of plants viz., barley, wheat, oats and triticale are used. Barley is preferred for blends because of its rapid growth and the suppression of weeds, but it is not desirable because it reduces the nutritional value in the case of delayed form due to the awn character. Özduven et al. (2010), in silage samples opened at the end of fermentation period of 45 days triticale silage, pH value, crude protein, lactic acid, acetic acid contents and silage loss ratios were found, respectively 4.5%, 8.5%, 7.3%, 5.0% and 5.8%. Demirci et al. (2011) reported that the pH value, HP, LA and AA contents were 4.6%, 13.6%, 5.3% and 2.3%, respectively, in the silages prepared from the mixture of 30% triticale + 70% others. Triticale is grown in all types of soil, but also at very high durability and high yields in arid areas. Triticale growing in the Marmara region is increasing day by day.

There are very few studies on the quality characteristics of the triticale genotypes in the region. It was aimed to determine the ranges in some quality characteristics of 20 genotypes including 3 triticale, 2 rye, 3 bread wheat, 3 durum wheat, 6 barley and 3 oat varieties in the study. The triticale genotypes in the study were compared with cool season cereals which could be used for the same purpose. The quality characteristics of the other plants used in the grass mixtures and of the triticale were compared.

Materials and Methods

In the study, 1. Aslım (rye), 2. Esperia (bread wheat), 3. Golia (bread wheat), 4. Karma 2000 (triticale), 5. Kızıltan 91 (durum wheat), 6. NKU Ziraat (durum wheat) 7. Pedujevo (rye), 8. Presto (triticale), 9. Selimiye (bread wheat), 10. Sladoran, (barley), 11. Herb, 12. Tatlıcak 97 (triticale), 13. Zenit (durum wheat) 14. Barberousse (barley), 15. Bolayır (barley), 16. Harman (barley), 17. Kırklar (oat), 18. Lord (barley), 19. Martı (barley) and 20. Sebat (oat) varieties was used as genetic material.

The study was established in the experimental areas of Tekirdag NKU Faculty of Agriculture Field Crops Department. The experiment was carried out in 3 replicated Tekirdağ and Lüleburgaz locations according to randomized completed block design.

In the study, genotypes were sown as 3 replications in total 6 m^2 parcels with 1.2 x 5 meter with parcel sowing machine in each location.

In the study, chemical pesticides were applied against weeds. Plant samples were taken for measurements and weights in the plants that came to the harvest maturity and the plants were harvested by parcel harvesting. Crude protein, crude fat, dry matter, crude ash, crude cellulose and starch analyzes were performed according to AOAC (1990) in the genotypes studied in the study. Analysis of insoluble fiber (NDF), acid soluble insoluble fiber (ADF) and acid soluble insoluble lignin (ADL) in neutral solvents were determined according to the method reported by Goering and Van Soest (1983).

Results and Discussion

Variance analysis was performed on the quality characteristics obtained in 20 genotypes examined and the differences between genotypes for all the characters were found statistically significant. The significance groups among the mean values examined were made by Tukey test and the obtained values were given separately. The mean values and the significance groups for crude protein, raw ash and crude oil contents are given in Table 1.

The crude oil in the triticale, barley, wheat, oat and rye cultivars varied between 1.16-1.71%. The highest crude oil was obtained in Harman barley variety with 1.171%, followed by Zenit durum wheat variety and Barberousse barley variety. Bolayır barley variety, Lord barley variety and NKU Ziraat Durum wheat variety were ranked after these genotypes in terms of fat ratio. The lowest crude oil was obtained in the oat variety Kahraman, followed by the Gelibolu bread wheat variety in the same statistic group. Sebat oat variety, Esperia bread wheat variety and Selimiye bread wheat variety are listed later. The crude fat content and the tritical genotypes were in the middle order. The triticale genotypes were in the middle order due to the crude oil content.

When genotypes were examined for crude ash content, this value varied between 1.52-2.27%. The highest amount of crude ash was obtained in Martı barley and Kırklar oat variety with 2.70%, followed by Kahraman oat variety in the same statistic group. Sebat oat variety, Bolayır barley variety and Sladoran barley variety were later included. The Karma 2000, Presto 2000 triticale and Pedujevo rye varieties were in the middle group in terms of crude ash content.

Starch content in the genotypes of the different species examined varied between 44.20% and 59.88% (Table 2). The highest starch was obtained in Gelibolu bread wheat variety. Selimiye bread wheat and Kızıltan 91 durum wheat varieties have the same statistic in this variety. Esperia bread wheat, Aslım rye and NKU Ziraat durum wheat, Presto 2000 triticale, Karma 2000 triticale and Pedujevo rye varieties were listed later. The lowest starch content was obtained in Kırklar oat varieties with 44.20%, followed by Sebat and Kahraman oat varieties. Bolayır and Lord barley varieties are listed later. The obtained data show that Triticale and bread wheat genotypes are superior in terms of starch ratio whereas barley varieties have low starch content.

The difference between the genotypes examined in terms of raw cellulose was found statistically significant and the cellulose ratio varied from 2.57 to 8.02 %. The lowest raw cellulose was found in Selimiye bread wheat variety, followed by Gelibolu bread wheat variety, NKÜ Ziraat and Kızıltan 91 durum wheat varieties. The highest crude cellulose was found in the Sebat oat variety, followed by the oat varieties of Kırklar and Kahraman, barley varieties of Barberousse and Martı. The values obtained indicate that the ratio of crude cellulose is lower in bread wheat varieties. Triticale genotypes were in the middle in terms of these characteristics. The moisture content of grains varied between 10.67-12,60% in varieties. There are no values that vary in quality attributes that affect this feature.

The NDF ratio in the examined varieties varied between 10.67-12.60%. The highest NDF ratio was 12.60% in Pedujevo rye variety, followed by 95 rye variety and Karma 2000 triticale variety. Gelibolu bread wheat variety, Selimiye bread wheat variety, Harman barley variety, Esperia bread wheat variety and Tatlıcak 97 triticale varieties are listed later. The lowest NDF value was obtained in the range Kırklar oat variety, followed by variety of Sebat oat, barley varieties of Bolayır and Barberousse (Table 3).

The obtained data show that the three triticale varieties were in the first order in terms of NDF content. The obtained data show that the triticale variety is very suitable for NDF value which is an important criterion of animal nutrition. On the contrary, these values are found to be the lowest in barley and oat. The difference between the mean values obtained from the ADF content was statistically significant. The highest ADF ratio was found in the Harman barley variety, followed by Esperia bread wheat variety, Martı barley variety, Sebat and Kırklar oat varieties.

The lowest ADF was found in Aslım rye variety, followed by NKU Ziraat and Zenit durum wheat varieties, Gelibolu bread wheat variety, Karma 2000 triticale variety, Tatlıcak 97 triticale variety, Kızıltan 91 durum wheat variety and Presto 2000 triticale variety. Triticale genotypes showed the most suitable characteristics with durum wheat cultivars due to the low NDF ratio required for animal feeding.

ADL content in 20 varieties examined showed a wide variation between 0.83-2.83%. The highest ADL was found in Selimiye bread wheat variety with 2.83%, followed by Pedujevo rye variety, Kızıltan 91 durum wheat variety, Sladoran, Barberousse and Bolayır barley varieties The lowest ADL rates were found in the NKU Ziraat durum wheat variety, followed by Lord barley variety, Zenit durum wheat variety, Heroic oat variety, Martı barley variety, Presto 2000, Tatlıcak 97 and Karma 2000 triticale. The data obtained indicate that the triticale genotypes are suitable for feeding with low ADL values.

Conclusion

The contents of crude protein, crude oil, crude cellulose, starch, NDF, ADF and ADL contents which are important for animal feeding in triticale, bread wheat, durum wheat, barley, rye and oat varieties in the study were investigated.

According to the obtained data, the varieties of durum wheat, barley and triticale in terms of protein ratio, barley and oat varieties in terms of raw ash content, bread and durum wheat varieties in terms of starch ratio, rye and tritical varieties in terms of raw cellulose ratio, bread and durum wheat in varieties in durum wheat, triticale genotypes, Triticale, bread wheat and rye varieties in terms of NDF ratio, varieties of ADF durum wheat, rye and triticale genotypes, ADL ratio in bread wheat, triticale and durum wheat genotypes were found to be most suitable.

When the quality characteristics examined are evaluated, triticale is the most suitable species together with bread wheat in terms of animal feeding quality compared to alternative grains. The considering abiotic stress factors, disease and pest, triticale is the most suitable species for animal feeding.

Table 1. Mean values and significance groups for protein, ash and fat ratio.

Genotypes	Protein (%)	Genotypes	Oil (%)	Genotypes	Ash (%)
13	15.35 a	16	1.710 0	19	2.27 a
6	15.30 a	13	1.710 a	17	2.27 a
15	15.30 a	14	1.710 a	11	2.24 a
16	14.40 b	15	1.660 b	20	2.17 ab
12	14.25 c	18	1.660 b	15	2.10 ab
5	14.05 d	6	1.660 b	10	2.05 ab
8	14.05 d	1	1.615 c	16	2.05 ab
18	14.00 e	4	1.615 c	14	2.03 ab
4	13.90 e	5	1.613 c	18	2.03 ab
2	13.50 f	19	1.612 c	7	1.83 ab
10	13.10 f	8	1.610 c	1	1.82 ab
14	12.60 g	10	1.610 c	4	1.78 ab
9	12.55 h	7	1.560 d	8	1.78 ab
19	12.55 h	12	1.560 d	6	1.70 ab
3	12.50 g	9	1.520 e	5	1.68 ab
11	12.00 ı	2	1.520 e	2	1.67 ab
7	11.55 j	20	1.460 f	9	1.67 ab
1	11.35 k	3	1.430 fg	3	1.62 ab
17	10.60 l	11	1.410 g	12	1.60 ab
20	10.02 m	17	1.160 h	13	1.52 b

Table 2. Mean values and significance groups for starch, cellulose and moisture content.

Genotypes	Starch (%)	Genotypes	Cellulose (%)	Genotypes	Moisture (%)
3	59.88 a	20	8.02 a	7	12.60 a
9	59.78 a	17	7.88 a	1	12.33 ab
5	58.87 a	11	6.47 b	4	12.23 b
2	58.85 b	14	5.07 c	3	12.18 b
1	58.65 b	19	5.05 c	9	12.17 b
6	58.10 c	15	4.95 cd	16	12.12 b
8	57.97 cd	18	4.83 de	2	12.12 b
12	57.88 cd	10	4.77 de	12	12.10 b
4	57.80 cd	16	4.75 e	8	12.07 bc
7	57.77 de	7	2.86 f	11	11.78 cd
13	57.48 e	13	2.81 f	13	11.77 d
10	50.25 f	4	2.77 fg	18	11.72 d
14	50.13 f	1	2.73 fgh	10	11.70 d
19	49.63 g	8	2.72 fgh	5	11.63 de
18	49.58 gh	12	2.71 fgh	19	11.55 def
15	49.28 h	2	2.69 fgh	6	11.50 def
16	48.75 ı	5	2.67 fgh	14	11.40 efg
11	46.73 j	6	2.67 fgh	15	11.30 fg
20	45.58 k	3	2.58 gh	20	11.13 g
17	44.20 l	9	2.57 h	17	10.67 h

Table 3. Mean values and significance groups for NDF, ADF, and ADL properties.

Genotypes	NDF	Genotypes	ADF	Genotypes	ADL
7	12.60 a	16	9.32 a	9	2.83 a
1	12.33 ab	2	7.86 b	7	2.45 b
4	12.23 b	19	6.79 c	5	2.23 c
3	12.18 b	20	6.70 c	2	1.92 d
9	12.17 b	17	6.70 c	10	1.91 d
16	12.12 b	9	6.34 d	15	1.83 e
2	12.12 b	10	6.29 de	14	1.81 e
12	12.10 b	14	6.15 de	20	1.75 f
8	12.07 bc	15	6.08 e	17	1.73 g
11	11.78 cd	11	5.85 f	1	1.65 h
13	11.77 d	18	5.70 fg	3	1.62 ı
18	11.72 d	7	5.59 g	16	1.52 j
10	11.70 d	8	5.51 gh	4	1.49 k
5	11.63 de	5	5.34 hı	12	1.48 k
9	11.55 def	12	5.19 ıj	8	1.30 l
6	11.50 def	4	5.12 j	19	1.30 l
14	11.40 efg	3	4.79 k	11	1.10 m
15	11.30 fg	13	4.20 l	13	1.03 n
20	11.13 g	6	4.05 l	18	0.99 o
17	10.67 h	1	3.80 m	6	0.83 p

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