GIDA (2015) 40 (4): 187-192
doi: 10.15237/gida.GD15025

Research / Araştırma

INVESTIGATION on QUALITY CHARACTERS and CORRELATIONS AMONG HARDNESS with OTHERS in BREAD WHEAT*

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Received / Geliş tarihi: 06.03.2015
Received in revised form / Düzeltilerek Geliş tarihi: 23.06.2015
Accepted / Kabul tarihi: 29.06.2015

Abstract

Two variety candidate bread wheat, ESOGUZF-1 and ESOGUZF-2 which were improved from the crosses between widely grown winter cultivars Bezostaja 1, Dağdaş 94 and Kınacı 97 were planted together with the parents in Randomised Complete Blocks Design to compare for hardness (HD), protein content (PC), sedimentation value (SV), gluten content (G) and gluten index (GI) and study on correlation between hardness and the others. Values obtained from analysis of the traits were indicated that both lines are suitable for quality bread making. The genotypic and phenotypic variances and the heritability estimates were present high values for investigated traits. Significant and positive correlations were determined between hardness and gluten and gluten index in lines. Considering the interest of industry, farmers and breeders who evaluating the quality of wheat for several uses, this study present lines can be use for those purposes.

Keywords: Wheat, quality, hardness, variation, correlation

EKMEKLİK BUĞDAYDA SERTLİK İLE KALİTE ÖZELLİKLERİ ARASINDAKİ İLİŞKİLERİN ARAŞTIRILMASI

Özet

Üç ekmeklik buğday çeşidinin (Bezostaja 1, Dağdaş 94 ve Kınacı 97) melezlenmesi ile geliştirilen ESOGUZF-1 ve ESOGUZF-2 çeşit adayları tesadüf blokları deneme desenine göre ekilmiştir. Adayların sertlik ile protein içeriği, sedimantasyon değeri, gluten içeriği ve gluten indeksi arasındaki korelasyonu incelenmiştir. Elde edilen sonuçlara göre her iki çeşit adayının kaliteli ekmek yapımına uygun olduğu belirtilmiştir. Elde edilen sonuçlara göre genotipik varyans, fenotipik varyansın önemli, kalıtım derecesi ise yüksek olduğu tespit edilmiştir. Çeşit adaylarının sertlik ile gluten ve gluten indeksi özellikleri arasındaki korelasyonun önemli ve olumlu çıkmıştır. Denemede kullanılan çeşitlerin adaylarının kalite özellikleri incelendiğinde çeşit adaylarının ıslah programlarına dâhil edilmesi ve üreticilere kullanıma sunulması tavsiye edilmektedir. Elde edilen sonuçlara göre buğday kalitesi dikkate alındığında her iki çeşit adayının da üreticiler, sanayiciler ve ıslahçılar için kullanımı uygun görülmüştür.

Anahtar kelimeler: Buğday, kalite, sertlik, varyasyon, korelasyon

* *This article is a part of master thesis of Zekiye Budak Başçiftçi* / Bu makale Zekiye Budak Başçiftçi'nin Yüksek Lisans Tezinin bir bölümüdür

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INTRODUCTION

Wheat has always been a significant crop in Turkey due to its importance in Turkish diet and agricultural economy. It is widely utilize as bread, bulgur, biscuits, cuscus and macaroni (1).

Population increases in Turkey, same as worldwide in general, demands parallel increase in food production, particularly of wheat. The sectors involved in the production, trading and industrialization of wheat (*Triticum aestivum L.*) are interested in several aspects of its quality. The need of quality wheat grain that fulfills the requirements of the consumers increases the demands of breeding programs which can obtain improved cultivars with better grain quality associated with higher yield. Many quality traits although affected by environmental factors, are under genetic control, which allows manipulation and selection by the breeders (2).

Grain hardness is one of the most important determinants of wheat quality (3, 4) because of it influences on the end-use quality and also yield. Hard or medium hard grain is preferred for manufacture of leavened and flat breads because the levels of damaged starch produced from these wheat classes are appropriate to achieve to high dough water absorption desired by the baker. Their strong flour doughs are also more suitable for mechanized production of leavened breads (5, 6).

On the other hand grain protein content and protein quality are two other major contributors to nutritional quality and plays a decisive role in baking performance of wheat flour (7). Although it is influenced by climate and cultural practices (8-10), genes for high grain protein effectively increase the wheat grain protein content in many different environments (11- 13). Heritability estimates for protein content has ranged from 15 to 83 % (14, 15).

Protein quality, mainly gluten is responsible for most of viscoelastic properties of wheat flour doughs and gluten viscoelasticity is commonly known as flour or dough strength (16). One another indicator for protein quality is sedimentation value and the Zeleny sedimentation test can be used to obtain estimation of gluten strength (17).

The objective of this study was to investigate main grain quality characters of two hard grain bread wheats in comparison with the parents and to determine if any correlations exist between hardness and other quality traits.

MATERIALS and METHODS

Materials used in this study were two winter type variety candidates (ESOGUZF-1 and ESOGUZF-2) and its parents (Bezostaja-1, Dağdaş 94 and Kınacı 97) which are widely grown wheat cultivars in Turkey. Bezotaja-1 and Dağdaş-94 are possess hard grains with high protein content while Kınacı 97 has semi-hard grains, rather less protein but higher yielding potential. ESOGUZF-1 was improved from the crosses of Kınacı 97 and Bezostaja-1 while ESOGUZF-2 was improved from the crosses of Kınacı 97 and Dağdaş 94.

The field experiment was conducted using these candidates and the parents together in 2005-2006 growing season at research fields of Agricultural Faculty of Eskişehir Osmangazi University, Eskişehir, Turkey, in randomized complete blocks design with four replications. Growing techniques such as fertilizing, weed control ext. were done as regular bases and sprinkler irrigation was applied during stem elongation and heading stages. Hardness (HD) and protein content (PC) of grains were determined as dry weight basis by near-infrared reflectance spectroscopy, using Inframatic 8600 (Perten Instruments, Sweden). The value of hardness required to be in between 40-56. Between 49-56 as medium hard, generally preferred for better bread making quality. Protein content over than %12 is acceptable for good bread making quality. Sedimentation values (SV) were determined by the Zeleny Sedimentation Test according to ICC Standards 116 (18). Sedimentation values evaluated as > 15 ml weak, 16-24 ml medium, 25-36 ml strong and over 36< very strong gluten (19). The parameters of wet gluten (G) and gluten index (GI) were determined by ICC standards 137 (20), 155 (21) and 158 (22) using a Glutomatic 2200 instrument (Perten Co., Huddinge, Sweden) on white flour milled on a Brabender Quadromat Junior. 27 g and above accepted as high and less than 20 g as low in gluten. The gluten index was determined using a Centrifuge 2015, according to ICC Standard Method No. 151 (23), and 90 % accepted as high while less than 50 % as low in gluten index (24).

RESULTS and DISCUSSION

There were significant differences among the candidates and the parents for investigated characters that indicate a considerable range of genetic variability (Table 1). ESOGUZF-1 has given high values for all traits desirable to make good bread. In comparison with parents it was better for hardness; protein content, sedimentation value and gluten content than the female parent Kınacı 97. It was only higher for gluten index than male parent Bezostaja-1 while lower for other characteristics.

ESOGUZF-2 was superior to both parents for hardness, protein content and gluten content but inferior to female parent Kınacı 97 for gluten index and to male parent Dağdaş 94 for sedimentation value and gluten index. It also had better values for protein content and gluten content than Bezostaja-1.

ESOGUZF-1 and ESOGUZF-2 are good flour yielder due to their endosperm virtuousness as reported by Dobraszczyk (1994) (25) and Haddad et al. (1999) (26). Both are suitable to easy mill since they give readier separation of bran from endosperm after conditioning and the liberated flour are more mobile and easier to shift.

Hardness determined from ESOGUZF-1 was acceptable for good bread making while value of ESOGUZF-2 was slightly over than required level. Under same conditions grain hardness of Bezostaja -1 also exceeds the upper limits.

Protein contents obtained from both lines were quite high and over desired level for good quality bread making.

The highest gluten content was determined in ESOGUZF-2 as 42.45 g which mean a good technological quality of flour and dough. Graybosch et al. (1996) (27) were reported that the bread making quality of flour is influenced both by protein content and protein type.

Although hardness in ESOGUZF-1 was correlated positively with all other characters but correlation with gluten content was significant and positive. In ESOGUZF-2 same as ESOGUZF-1 hardness was showed positive correlation with all other characters. However it was only correlated significantly with gluten index.

Sedimentation values were varied in candidates and the parents that ranged from 36 ml (Kınacı 97) to 50.75 (Dağdaş 94). Values obtained from the candidates were high that indicate high quality of proteins and good bread-making quality. It is well-known that sedimentation value and gluten content are important quality traits because of their positive correlations with other bread making quality parameters of wheat (28, 29).

Heritability in broad sense was estimated 85 % for hardness and 99 % for gluten content. Genotypic and phenotypic variance were close to each other for protein content, gluten content, gluten index and sedimentation value. Phenotypic variances for hardness were higher than genotypic variance. As Bushuk (1998) (11) pointed out, this result also might be come into being due to environmental conditions.

High heritability of sedimentation value and gluten index coupled with considerable genetic advance in these crosses has indicate that additive gene effects exist for these traits in the lines (Table 2). Results obtained in this study indicated that selection based on these traits could be effective in improving quality.

Table 1: Values of quality parameters and analysis of variance for two improved lines and the parents.

	Protein Content (PC) (%)	Hardness (HD)	Sedimentation Value (SV)	Gluten Content (G)	Gluten Index (GI)
ESOGUZF-1	14.00	55.50	46.00	35.38	92.50
ESOGUZF-2	15.00	57.50	37.25	42.45	77.25
KNC	13.33	51.75	36.00	28.53	97.50
BEZ	14.83	58.25	50.00	39.60	88.25
DDŞ	14.58	51.75	50.75	33.35	97.25
Replications	0.00	0.32	0.13	0.19	2.05
Treatments	1.87	38.17	195.13	117.75	279.18
Crosses	2.00	8.00	153.13	100.11	465.13
Parents	2.58	56.33	276.08	123.33	111.08
P. vs. C.	0.32	32.03	75.21	124.24	429.41
Error	0.02	0.27	2.84	0.92	1.11
LSD %5	0.21	0.08	2.60	1.48	1.62

Table 2: Genetic parameters for the quality characters in the lines and parents

	Genotypic Variance	Phenotypic Variance	Heritability	Genetic Advance
PC	0.50	0.51	0.98	9.92
G	0.25	0.25	0.99	2.64
GI	114.42	121.88	0.94	25.15
SV	38.00	39.13	0.97	30.07
HD	1.92	2.25	0.85	4.66

Table 3: Phenotypic correlation between hardness and the quality characters in the lines

Correlation	Hardness	
	ESOGUZF-1	ESOGUZF-2
PC	0.82	0.91
G	1*	0,92
GI	0.58	0.98*
SV	0.58	0.77

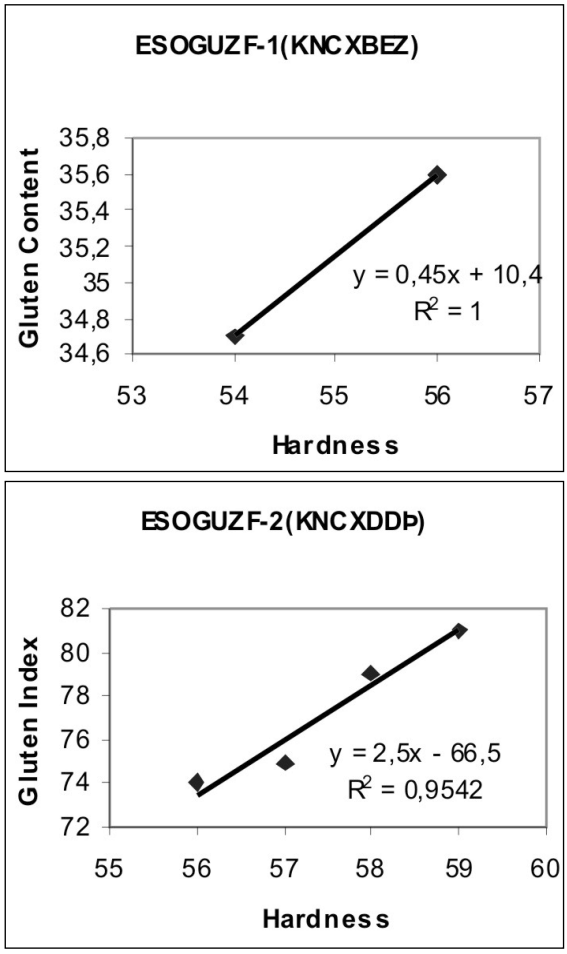

Figure 1: Relationship between gluten content, gluten index and hardness respectively for ESOGUZF-1 , ESOGUZF-2

Correlations was ranged from 0,58 to 1 in the ESOGUZF-1 and ESOGUZF-2 for all characters. Highest and significant correlation was obtained between hardness and gluten content in ESOGUZF-1. Gluten index was significantly correlated with hardness in ESOGUZF-2 (Table 3). According to regression analysis, variations in quality parameters accounted to ESOGUZF-1 and ESOGUZF-2 were 100% and 95% respectively (Figure 1).

CONCLUSION

Many quality traits although affected by environmental factors are under genetic control, which allows manipulation and selection by breeders (5).

The values obtained for all studied characters were indicated that ESOGUZF-1 and ESOGUZF-2 were suitable for production of leavened and streamed breads and hamburger, hotdog buns. Considering the interest for industry, farmers and breeders who evaluating the quality of wheat for several uses, this study present lines with a good technological quality of the grain.

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