DIFFERING IN AGRONOMIC AND QUALITY CHARACTERS IN SOME BACKCROSS–DERIVED LINES IN BREAD WHEAT (*Triticum aestivum* L.) GENOTYPES

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Abstract
The backcrossing method remains an efficient tool for transferring genes into established crop varieties. In this study; we were focused on evaluating the selected some backcross lines for yield, grain-quality traits and some agronomic traits under field condition. The experiment was conducted using 15 genotypes in randomized completely blocks design with four replications in Trakya ARI experimental field, during 2009-2010 and 2010-2011 growing years. Grain yield, days of heading and maturing, plant height and some quality parameters and relationship among these parameters were investigated. According to results, there was statistically difference among genotypes in terms of yield and other investigated characters, except for 1000-kernel weight, test weight. Grain yields decreased in Pehlivan, Aldane, Tekirdağ and Dropia backcross lines. It was determined that TKW increased in the backcross derived lines of the Gelibolu, Dropia and Prostor, gluten value increased in Pehlivan and Tekirdağ cultivars. Backcross line for gluten index of the Pehlivan, Aldane, Gelibolu, Prostor and Dropia cultivars highly increased compared with other components. Sedimentation values of the backcross lines of cultivars decreased in Prostor and increased in Pehlivan, Gelibolu and Dropia. The strongly negative correlations were measured between grain yield and days of maturing (r=-0.689**), plant height (r=-0.655**), and lodging resistant (r=-0.743**). Also, grain yield was negatively correlated with protein ratio (r=-0.608*), gluten value (r=-0.541*), and days of heading (r=-0.607*). The negative correlations were found between grain yield and 1000-kernel weight, test weight, hardness, sedimentation, and winter-kill, as well. The strong positive correlations were measured between protein ratio and gluten, hardness, sedimentation, days of heading and maturing, plant height, and lodging resistant. Grain hardness in genotypes increased with the extension of maturation period of the genotypes. Plant height in genotypes strongly correlated with grain yield, protein ratio, gluten value, gluten index, days of heading and maturing.

Keywords: Bread wheat, backcross lines, genotypes, agronomic characters.

Introduction

Bread wheat is the mainly crops is grown in Trakya region and because of the various environment condition biotic and abiotic stress factors causes its yield and quality. Due to fluctuation of rainfall in some growing year causes decrease in grain yield, yield component and quality in wheat production area (Öztürk and Korkut, 2015). Almost all breeding programs in the world aim to improve varieties with stable yields. The yield stability is generally grouped as static or dynamic stability (Pfeiffer and Braun, 1989). Success of a wheat breeding program depends on the regional adaptability, improved and adaptability of cultivars in the target environments determined by its tolerance to biotic and abiotic stresses. The most important abiotic stress factor is the shortage of rainfall in the region (Altay, 2012). Consistency in yield has always been a problem in crop production due to the strong influence of environmental effects during the various stages of crop growth (Yan and Hunt, 2001; Viana and Cruz, 2002). Improvement of end-use quality in bread wheat depends on a thorough understanding of current wheat quality and the influences of genotype, environment, and genotype

by environment interaction on quality traits (Yong et al., 2004). Environmental factors play a main role in the expression of genotype characteristics (Peterson et al., 1998). Protein content is in turn influenced mainly by nitrogen fertilization, while the protein quality is determined primarily by the wheat genotype (Samaan et al., 2006). On the other hand, both the quality and the content of the wheat protein are affected by the climatic conditions during wheat maturation (Johans and Svensson, 1998). The effects of genotype x environment were significant on grain quality. Genotype and environment had more effects on flour protein ratio, gluten content, sedimentation value and 1000-kernel weight (Öztürk et al., 2017). Wheat yield potential in Trakya region changes across region due to various environmental conditions. Temperature and rainfall pattern vary greatly from location to location, from year to year. Because of various environmental conditions there was significant difference among genotypes and locations over studied characters. The objective of backcrossing study is to develop a line as higher yield and agronomic character as possible to the recurrent parents and cultivars is producing in the region.

Material and methods

The experiment was conducted at Trakya Agriculture Research Institute experimental field Edirne, Turkey, during 2009-2010 and 2010-2011 growing year. Fifteen genotypes examined in randomized completely blocks design with four replications. All plots were sown into 6 rows, and plot sizes were 6 m^2 at harvesting. In the experiment 500 seed/m^2 was used at planting. The data for grain yield, 1000-kernel weight, test weight, protein ratio, gluten, gluten index, hardness, sedimentation, days of heading and maturing, plant height and relationship among these parameters were investigated. And all parameters compared with backcross derived line with parents. Pehlivan, Aldane, Tekirdağ, Gelibolu, Prostor, Dropia, Todora and Yantar cultivars was used for recurrent parents and backcross lines of those cultivars. Assessment of the genotypes based on investigated parameters carried out under field condition. Grain yield, thousand kernel weights and test weight, (Blakeney et al., 2009), protein ratio (% NIR AACC 39-10), grain hardness, gluten, gluten index, and sedimentation (Köksel et al., 2000; Anonymous, 2002; Anonymous, 1990) were investigated. The quality analysis of Zeleny sedimentation test and wet gluten content were determined according to ICC standard methods No. 116/1 and 106/2, respectively (Anonymous, 1984). Also, regression graphs are used to predict adaptability of genotypes. Data were analysed statistically for analysis of variance following the method described by Gomez and Gomez (1984). The significance of differences among means was compared by using Least Significant Difference (L.S.D. at a %5) test (Kalaycı, 2005).

Results and discussion

The results of variance analysis are presented in Table 1. It was showed that there was statistically difference among genotypes and backcross lines according to yield and other investigated characters excepted test weight and 1000-kernel weight. As a result, grain yields decreased in Pehlivan, Aldane, Tekirdağ and Dropia backcross line while backcross line of the Gelibolu and Prostor cultivars yield increased. TKW increased in the backcross derived lines of the Gelibolu, Dropia and Prostor, for gluten value increased in Pehlivan and Tekirdağ cultivars backcross lines. Also, backcross line for gluten index of the Pehlivan, Aldane, Gelibolu, Prostor and Dropia cultivars highly increased compared with other components. Sedimentation value of the backcross line of cultivars some decreased and some increased (Pehlivan, Gelibolu and Dropia). The grain yield varied from 587.5 kg da^{-1} for Bezostaja-1 to 780.6 kg da^{-1} for backcross line Bez/Prostor*6. Minimum grain yield of 587.5 kg da^{-1} was produced by a very old wheat cultivar Bezostaja-1, in contrast, maximum grain yield of 780.6 kg da^{-1} was produced by Bez/Prostor*6 backcross line. Averaged across years and cultivars the overall mean grain yield was 712.1 kg da^{-1}. This larger variation in grain yield may be due to diverse genetic and environmental factors and their interaction. Also, Bez/Gelibolu*6 and Bez/Prostor*6 backcross lines had higher yield than their parental cultivar. Plant height is important traits to

evaluation genotypes especially for lodging resistance. Lodging resistance is one of the mainly important traits in wheat cultivar in Trakya region. Plant height in genotypes varied from 95.0 cm to 130.0 cm and mean was 108.5 cm.

Bez/Aldane*6 and Bez/Tekirdağ*6 backcross lines had lowest plant height according to their parental cultivar and other genotypes. Earliness is other important characters and there was significant difference among genotypes and heading date varied from 120 to 131 days and mean was 124.4 days. Bez/Prostor*6 backcross lines had than their parental cultivar and other genotypes 1000-grain weight, a very important yield component in wheat, varied from 30.9 g to 39.0 g and mean was 35.0 g and Aldane had the highest 1000-kernel weight. Bez/Prostor*6 and Bez/Dropia*6 backcross lines produced higher yield than their parental cultivar. Test weight is other very important quality component in wheat, varied from 78.2 g to 82.3 g and mean TKW was 79.8 g. Protein quality and quantity have received more attention than other quality attributes, partly owing to the significant influence imparted by protein on end-use product quality of both common wheat and durum wheat. Environmental factors, such as nitrogen fertilization, water and temperature, influence protein content (Sissons et al., 2005). In contrast, protein quality is largely under genetic control (Lerner et al., 2006). In this current study, protein ratio varied between 11.3% and 14.9% and mean protein ratio was 12.6%. The maximum protein ratio of 14.9% was produced by cultivar Bezostaya-1 cultivar. Also, Bez/Pehlivan*6 and Bez/Tekirdağ*6 backcross lines had higher protein ratio than their parental cultivar. Table 1 shows mean and ranges of variation for gluten value and gluten index in all genotypes were evaluated across locations. Gluten ratio of the genotypes varied from 28.1% to 42.1% and mean gluten was 34.3%. Bezostaya had the highest gluten ratio with 42.1%. Gluten index in genotypes varied 61.9% to 97.6%. This larger variation in gluten index may be due to diverse genetic and environmental factors. Bez/Pehlivan*6, Bez/Aldane*6, and Bez/Prostor*6 and Bez/Dropia*6 backcross lines had higher gluten index than their parental cultivars. Sedimentation in genotypes and backcross derived lines varied from 39.5 ml to 66.0 ml and the highest sedimentation was determined in Aldane and Bez/Aldane*6 line (66.0 ml). This variation of sedimentation is due to by environmental conditions, agronomic practice and genotypic traits. The mean sedimentation was 51.8 ml. The ranges of variation for hardness in all genotypes were evaluated at growing cycles. Hardness is affected by environmental conditions, agronomic practice and genotypic traits. Hardness in genotypes varied from 41.5 to 52.0 and mean value was 46.9 g. Bezostaya had the highest hardness. Bez/Aldane*6, and Bez/Gelibolu*6 and Bez/Dropia*6 backcross lines had higher hardness than their parental cultivars (Table 1). Correlations among characters were evaluated for the 15 cultivars included in this study. Correlation coefficients among the tested characters of cultivars in Edirne location were given in Table 2. Protein ratio, gluten, days of heading and maturating, plant height and lodging had negative effect for grain yield. In this study, grain yield was strongly negative correlated with days of maturing (r=-0.689**), plant height (r=-0.655**), and lodging resistant (r=-0.743**). Also, grain yield was negatively correlated with protein ratio (r=-0.608*), gluten value (r=-0.541*), and days of heading (r=-0.607*). It was found negative correlation between grain yield with 1000-kernel weight, test weight, hardness, sedimentation and winter kills. Protein content in the mature grain is largely determined by environmental and farm management factors, with genetics playing a minor role in being either low or high in protein content (Blakeney et al., 2009). Protein ratio was strongly positively correlated with gluten ratio (r=0.778**), grain hardness (r=0.646**), sedimentation (r=0.593*), days of heading (r=0.728**), days of maturing (r=0.700**), plant height (r=0.670**), and lodging resistant (r=0.704**). It was determined that a negative correlation between days of heading with plant height (r=0.690**), lodging resistant (r=0.696**), and between days of maturing with lodging resistant (r=0.805**). Grain hardness in genotypes increased with the extension of maturation period of the genotypes. Plant height in genotypes strongly correlated with grain yield, protein ratio, gluten value, gluten index, days of heading and maturing (Table 2).

Table 1. The mean value of the genotypes on agronomic physiological morphological and quality characters

Entry No	Genotypes	GY	TKW	TW	PRT	GLT	IND	HARD	SED	WK	DH	DM	PH	LOD
1	Bezostaya-1	587.5 g	34.5 ab	82.3 a	14.9 a	42.1 a	83.6 bc	52.0 a	54.0 abc	1.5 d	131.0 a	165.5 a	130.0 a	8.0 a
2	Pehlivan	711.2 b-e	35.9 ab	79.9 abc	13.2 b-e	39.3 ab	74.4 c	48.5 def	52.0 abc	1.5 d	127.5 b	162.5 ab	115.0 bc	6.0 b
3	Bez/Pehl*6	703.4 cde	35.7 ab	79.2 abc	13.6 abc	41.4 a	75.9 c	47.0 f	53.0 abc	1.5 d	128.5 b	163.0 ab	117.5 b	6.0 b
4	Aldane	693.3 de	39.0 a	80.3 abc	13.6 ab	36.9 bcd	94.1 ab	49.0 cde	66.0 a	2.5 b	122.5 de	161.0 b	110.0 b-e	6.0 b
5	Bez/Aldane*6	672.3 ef	37.8 a	80.3 abc	13.5 bcd	34.5 cde	96.5 a	50.0 bcd	66.0 a	2.5 b	123.5 cd	160.0 bc	107.5 cde	5.0 bc
6	Tekirdağ	739.2 a-d	35.4 ab	78.2 c	12.2 def	33.4 de	93.0 ab	47.5 ef	55.5 ab	1.5 d	124.5 c	160.5 b	97.5 fg	3.5 cd
7	Bez/Tekirdağ*6	712.2 b-e	33.9 ab	78.9 abc	12.4 b-f	33.6 de	92.0 ab	47.5 ef	54.0 abc	2.0 c	124.5 c	160.5 b	95.0 g	3.5 cd
8	Gelibolu	743.6 a-d	30.9 b	79.5 abc	12.1 ef	28.3 f	98.3 a	41.5 h	50.5 abc	1.5 d	124.5 c	159.0 bc	102.5 efg	4.0 cd
9	Bez/Gelibolu*6	752.5 abc	31.4 b	79.8 abc	12.1 ef	28.1 f	97.4 a	42.5 gh	51.0 abc	1.5 d	124.5 c	159.0 bc	107.5 cde	4.0 cd
10	Prostor	760.3 ab	35.4 ab	79.6 abc	11.8 f	30.9 ef	90.7 ab	42.0 h	53.5 abc	1.5 d	121.0 ef	156.0 c	102.5 efg	3.0 d
11	Bez/Prostor*6	780.6 a	35.7 ab	79.7 abc	11.6 f	30.9 ef	91.4 ab	42.0 h	39.5 c	1.5 d	120.0 f	156.0 c	105.0 def	3.5 cd
12	Dropia	726.2 bcd	34.0 ab	81.1 abc	12.4 b-f	32.7 de	95.7 a	49.0 cde	45.5 bc	0.5 e	123.0 cd	160.5 b	105.0 def	3.5 cd
13	Bez/Dropia*6	711.3 b-e	35.5 ab	81.6 ab	12.2 c-f	32.0 ef	97.6 a	50.5 abc	54.0 abc	0.5 e	124.0 cd	161.5 ab	107.5 cde	4.0 cd
14	Bez/Todora*6	631.6 fg	34.9 ab	78.8 bc	11.3 f	32.9 de	76.0 c	44.0 g	40.0 bc	3.5 a	123.5 cd	161.0 b	112.5 bcd	6.0 b
15	Bez/Yantar*6	756.5 ab	35.9 ab	78.3 bc	12.3 b-f	38.2 abc	61.9 d	51.5 ab	42.5 bc	2.5 b	124.0 cd	162.5 ab	112.5 bcd	6.0 b
Mean		712.1	35.0	79.8	12.6	34.3	87.8	46.9	51.8	1.7	124.4	160.6	108.5	4.8
C.V (%)		7.1	1.9	7	5	5.7	6.3	1.7	14	10.4	0.7	1.3	3.4	--
LSD (0.05)		50.7	3.3	5.4	1.4	4.2	11.9	1.7	15.4	0.4	1.9	4.4	7.9	1.9
F cultivar		**	ns	ns	**	**	**	**	*	**	**	*	**	**
F year		ns	*	**	**	**	*	**	**	**	**	**	**	**

Note: Significance at **: P<0.01 and *: P<0.05; GY: Grain yield (kg da^{-1}), TKW: 1000-kernel weight (g), TW: Test weight (kg), PRT: Protein ratio (%), GLT: Gluten (%), IND: Gluten index (%), HARD: Hardness (PSI), SED: Sedimentation (ml) WK: Winter kill (0-9), DH: Days of heading, DM: Days of maturing, PH: Plant height (cm), LOD: Lodging resistant

Table 2. The correlation coefficients among yield quality agro-morphological characters in Edirne locations

Traits	GY	TKW	TW	PRT	GLT	IND	HARD	SED	WK	DH	DM	PH
TKW	-0.200											
TW	-0.452	0.047										
PRT	-0.608*	0.340	0.526*									
GLT	-0.541*	0.511	0.160	0.778**								
IND	0.168	-0.223	0.365	-0.114	-0.652**							
HARD	-0.474	0.497	0.375	0.646**	0.703**	-0.289						
SED	-0.251	0.427	0.267	0.593*	0.200	0.421	0.345					
WK	-0.339	0.324	-0.490	-0.053	0.154	-0.423	-0.041	0.008				
DH	-0.607*	-0.152	0.282	0.728**	0.699**	-0.361	0.464	0.169	-0.108			
DM	-0.689**	0.146	0.280	0.700**	0.803**	-0.488	0.778**	0.159	0.066	0.850**		
PH	-0.655**	0.181	0.476	0.670**	0.727**	-0.524*	0.425	-0.029	0.110	0.690**	0.697**	
LOD	-0.743**	0.311	0.253	0.704**	0.812**	-0.610*	0.532*	0.105	0.410	0.696**	0.805**	0.904**

Note: Significance at **: P<0.01 and *: P<0.05; GY: Grain yield (kg da^{-1}), TKW: 1000-kernel weight (g), TW: Test weight (kg), PRT: Protein ratio (%), GLT: Gluten (%), IND: Gluten index (%), HARD: Hardness (PSI), SED: Sedimentation (ml) WK: Winter kill (0-9), DH: Days of heading, DM: Days of maturing, PH: Plant height (cm), LOD: Lodging resistant

Grain yield and investigated quality parameters were assessed and it was found various relationships based on genotypes and environment interaction. As it expected there was negatively relation between grain yield with protein ratio (R^2=0.369), and gluten value (R^2=0.292). Also, it was found slightly and negatively relation between yield and winter kill (R^2=0.115). This result showed that genotypes which have resistant to winter kill had the highest grain yield. There was negative relation between grain yield and test weight (R^2=0.203). There was positively relation between protein ratio with test weight (R^2=0.276) and 1000-kernel weight (R^2=0.115). Gluten value was positively correlated with TKW (R^2=0.260), and negatively correlated with gluten index (R^2=0.425).

Conclusions

According to results, there was statistically difference among genotypes in terms of yield and other investigated characters, except for 1000-kernel weight, test weight. Grain yields decreased in Pehlivan, Aldane, Tekirdağ and Dropia backcross lines. It was determined that TKW increased in the backcross derived lines of the Gelibolu, Dropia and Prostor, gluten value increased in Pehlivan and Tekirdağ cultivars. Backcross line for gluten index of the Pehlivan, Aldane, Gelibolu, Prostor and Dropia cultivars highly increased compared with other components. Sedimentation values of the backcross lines of cultivars decreased in Prostor and increased in Pehlivan, Gelibolu and Dropia. The strongly negative correlations were measured between grain yield and days of maturing, plant height, and lodging resistant. Also, grain yield was negatively correlated with protein ratio, gluten value, and days of heading. The negative correlations were found between grain yield and 1000-kernel weight, test weight, hardness, sedimentation, and winter-kill, as well. The strong positive correlations were measured between protein ratio and gluten ratio, grain hardness, sedimentation, days of heading, days of maturing, plant height, and lodging resistant. It was measured negative correlations between days of heading and plant height, and lodging resistant. Grain hardness in genotypes increased with the extension of maturation period of the genotypes. Plant height in genotypes strongly correlated with grain yield, protein ratio, gluten value, gluten index, days of heading and maturing. Overall, the results of the investigated parameters demonstrated that the environmental conditions such as temperature and rainfall during grain filling period, agronomic

practices, and wheat genotypes could affect the grain physical characteristic and hence the grain quality. It was concluded that an increase in some investigated parameters backcross program could be used in breeding program to develop better genotypes.

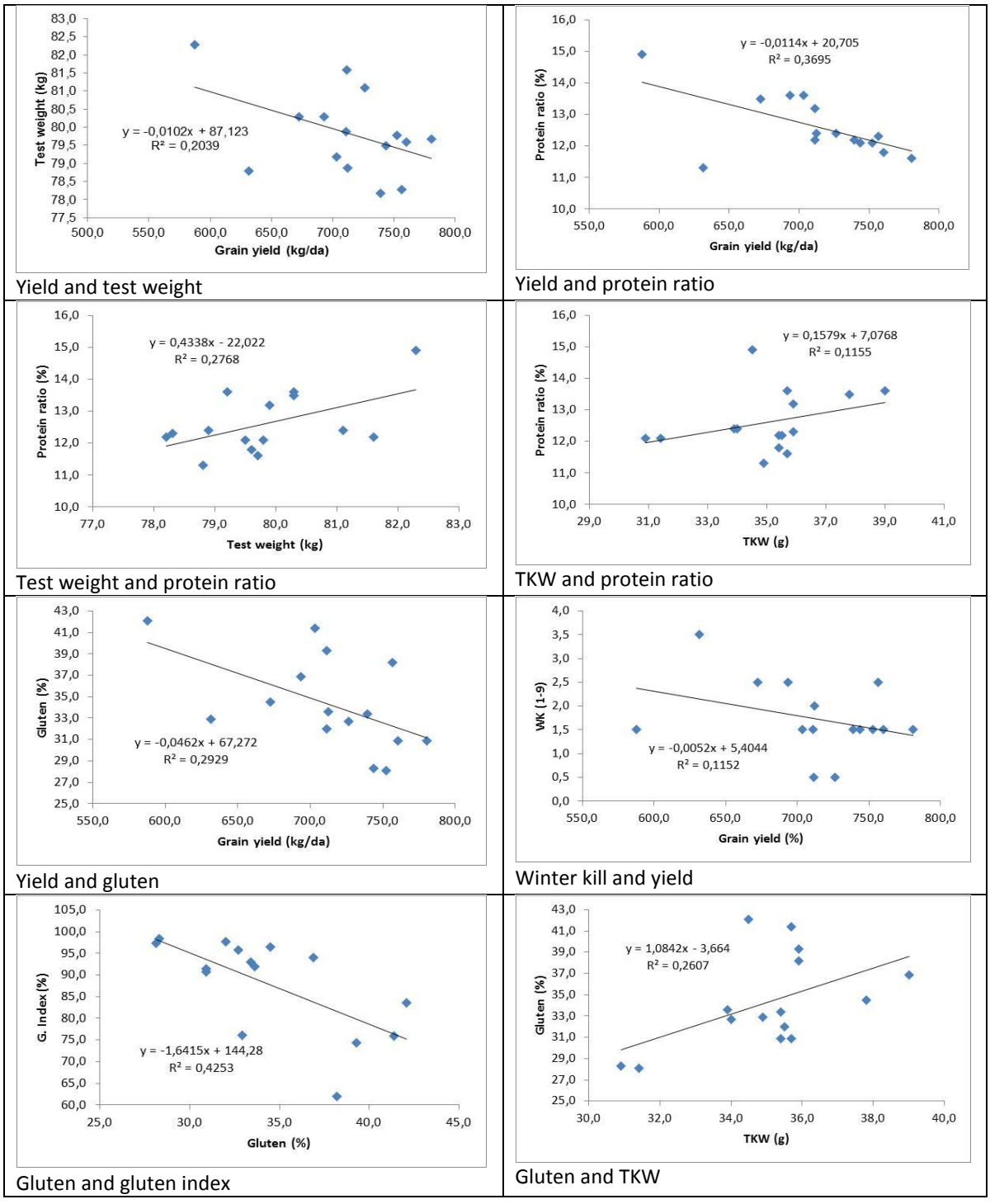

Figure 1. Relation among yield and yield component and quality parameters

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