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Determination of Rheological and Bread Making Properties of Some Bread Wheat (*Triticum aestivum* L.) Cultivars after Different Cover Crops

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Abstract This research was carried out at Central Research Institute for Field Crops, Department of Quality Technology and Food during 2010-2011 years. Alveograph, pharinograph and bread-making properties of four bread wheat cultivars (Bayraktar 2000, Eser, Gerek 79 and Tosunbey) sown after nine different cover crops (fallow, continuously wheat, chickpea, winter lentil, spring oat, spring lentil, sunflower and safflower) were investigated. According to the results; principal component analysis of yield and quality parameters for two years showed that Tosunbey gave the best values after different fore crops for quality and final product as bread. It was concluded that Eser variety had good yield and quality values for aggregates under favorable climatic conditions. It should be advised that safflower and sunflower can be used in crop rotation systems and they gave high quality products for bread in Central Anatolia.

Keywords Cover crop, crop rotation, bread wheat, rheology, bread making

1. Introduction

Wheat, which is a basic nutrient and strategic product, has an important place in our country as well as in the world. Sowing area and production takes the first place in our country and considering this importance will continue in the coming years, increasing of production will be possible with the increase of productivity. In addition to this, it is necessary to maintain the quality of bread wheat to be obtained while increasing the yield. Changes in consumer demands are an indication of the importance given to end product quality. In agriculture, crop rotation practices are carried out on the basis of continuity of production and the yield of the product stands out much more. However, the quality and rheological properties of the obtained product during processing and up to the final product directly affect the quality of the final product. At the same time, in the agricultural fields where applied rotation the interaction with the soil, the amount of plant nutrients, the water in the soil and the fore crop effect are also important in terms of yield and quality. Under current economic conditions and production practices, producers adoption of rotation systems, especially in oilseeds and legumes, can increase production levels and profitability [1]. In wheat sowing after legume, positive improvements occur in protein content and alveogram properties of the grains [2-4].

In different forecrops and fallow soving areas, seed bed characteristics have different effects on soil moisture levels and nutrient amounts. For this reason, the yield and quality characteristics of wheat are greatly affected [5-6]. The ways to increase the yield were investigated by studies of rotation and successful results were obtained from agronomic applications. Especially; despite the positive results of seeding rate, different fertilizer doses and planting date trials, consumer and industrial demands were not taken into consideration during the processing of the wheat produced until the final product and the studies carried out on the issue were limited with protein content, zeleny sedimentation and some other quality parameters. In terms of suitability to the final product, nowadays in order to provide the developing consumer demands, there has not been much work in line with the demands of the industrialists and bakers. Yield and quality in wheat; genotype, environment and genotype x environment interaction is significantly affected [7]. However, in the years when the amount of precipitation is sufficient, the quality decreases with the increase in yield; especially in dry years, the decrease in yield is very sharp and although the relationship between quality and yield is opposite, the quality values decrease significantly as the amount of this decrease increases.

Wheat quality covers entirely some milling, kneading and bread characteristics and each one all is considered as a separate breeding character. Because quality components are affected by environmental conditions and hereditary characteristics at different rates. The quality factors that the wheat breeder can control best are physical and rheological factors.

In order to determine the most suitable cultivation techniques for registered durum and bread wheat varieties in our country, studies are carried out to increase the yield and quality characteristics. Again, it is important to clarify which wheat varieties should be planted in terms of quality after products such as chickpeas, sunflowers, vetch and lentils which are widely sown in Central Anatolia and the transition region. This study will help us to predict the performance of varieties under different rotation conditions and to develop suitable rotation systems in terms of rheological properties and final product bread quality of fore crop application in dry conditions in Central Anatolia. In this study, it was aimed to determine the effect of different fore crop applications (wheat, fallow, chickpea, winter vetch, winter lentil, summer oat, sunflower, summer lentil and safflower) to the rheological and final product bread making properties on Tosunbey, Eser, Gerek 79 and Bayraktar 2000 bread varieties.

2. Materials and Methods

2.1. Materials

The research was carried out in the area which can be considered as semi-base; The rheological and bread making properties of the flour obtained by milling that the samples produced from four different white-grain bread wheat varieties (Bayraktar 2000, Gerek 79, Eser and Tosunbey) plots sown after nine different forecrops plants were examined.

2.2. Methods

Harvested wheat samples; tempered for Chopin flour mill and milled according to the value of peels calculated from the grain (PI: pearling index) [8]. At the end of milling these flours which were rested and expected to maturation for two weeks were used in rheological analysis and bread making experiments.

2.2.1. alveograph

An improved device for measuring the resistance and extensibility of dough. Although the graphs obtained from the alveograph device are similar to those obtained from the extensograph device; unlike other dough rheology measuring instruments, the alveograph measures bi-directional spread and deformation. This bi-directional elongation (deformation) indicates the spread of cell gas in the swelling dough. Alveograph analysis was performed according to the method of Anonymous, 2000a [9].

2.2.2. farinograph

It is one of the most used dough testers for the dough quality assessment by researchers and industrialists. With the farinograph analysis, the resistance of the dough to the kneader pallets during kneading is recorded on the graph paper by means of a dynamometer. Farinograph analysis was conducted according to Anonymous, 2000b [10].

2.2.3. bread making

Bread is obtained as a result of cooking pulp which yeast, wheat flour, water and salt kneading mixed in a certain proportion and fermentating for a certain period. Bread making experiments was made according to Anonymous, 1969 [11].

All these quality analyzes are performed to determine the degree of compatibility of flour with bread or other bakery products. With these analyzes, the suitability of wheat, hence flour, can be estimated. As a result, it is possible to clearly see the results of all these quality analyzes with bread making analysis.

2.3. Statistical analysis

These obtained data was evaluated with correlation analysis and subjected to Principal Component Analysis by using JMP IN package statistics program (SAS Institute, Cary, NC, PC version 5.0).

3. Results and Discussion

3.1. Alveograph

Alveograph energy value (J: 10^{-4} Joule) is quite high between the years. While the average of all applications and varieties of the first year was measured as 53 J, this value was 110 J in the second year. In forecrop applications; The highest mean value after vetch application for the first year was 84 J, followed by sunflower (71 J) and winter lentil (69 J), respectively. The lowest value was obtained from summer lentil (27 J) application. In the second year; Summer oat forecrop application was the first with 136 J, followed by chickpea (127 J) and sunflower (111 J). The value obtained from the plots sown after 91 J vetch was the lowest energy value in the second year. In terms of energy values, Tosunbey and Bayraktar 2000 varieties had the highest values in all other fore crop applications except safflower planted in the first year, respectively. Tosunbey variety had the highest values in all fore crop applications in the second year and the other varieties that Gerek 79 cultivated after spring oat, Eser after wheat, winter and spring lentils and Bayraktar 2000 variety after all other forecrops except winter lentil. Table 1, which shows two-year results in terms of other alveograph P/G values related to the balance of gliadin and gluten and directly affecting bread texture and volume; Tosunbey cultivated after safflower and wheat in the first year and Bayraktar 2000 and Eser varieties after vetch and all other pre-plant applications have had alveograph P/G values suitable for bread. In the second year, after the vetch Gerek 79 and cultivated after the all other forecrops Tosunbey varieties gave alveograph P/G values for bread (Table 1).

Differences were observed between the alveograph analysis results over the years depending on rainfall and temperature. Accordingly, alveograph values were higher in the second year compared to the first year and were found to be more suitable for bread. In the first growing season, insufficient rainfall and high temperature, imbalance in the amount of precipitation falling in months and days during the month, especially in the development period of the plant can not reach the desired amount of precipitation and drought during the growing period as a result of the decrease in yield has also resulted in decreases in quality. Although the amount of precipitation is low in the first season and the decrease in yield creates an expectation of an increase in some quality parameters, the drought in may and the stress factor caused by the high temperature effect prevented this expected increase in quality. While the reactions of the varieties to the forecrop applications differed in terms of alveograph values, it was observed that Tosunbey cultivar gave suitable values to fermented oven type breads in both production years.

Table 1: Two years results of alveograph analysis on bread wheat cultivars sown after different fore crops

Fore crop	Cultivar	W (J)		P/G		L		P	
		1. Year	2. Year	1. Year	2. Year	1. Year	2. Year	1. Year	2. Year
Safflower	Bayraktar 2000	33	93	2.1	2.2	3.0	7.8	2.6	4.4
	Eser	36	55	2.1	2.0	3.8	5.4	2.9	3.2
	Gerek 79	37	63	1.6	2.0	5.8	7.7	2.7	3.9
	Tosunbey	34	213	5.4	6.9	15.0	5.0	4.6	10.8
Wheat	Bayraktar 2000	35	65	1.6	3.0	3.6	4.8	2.3	4.6
	Eser	26	82	2.2	1.5	3.9	9.3	3.4	3.3
	Gerek 79	24	47	1.5	3.3	5.2	3.2	2.8	4.1
	Tosunbey	39	208	5.4	5.6	7.4	6.0	5.1	9.7
Sunflower	Bayraktar 2000	69	113	1.8	3.2	6.9	6.4	3.4	5.7
	Eser	39	53	2.5	6.1	3.0	1.9	3.1	5.9
	Gerek 79	47	54	5.3	6.5	2.0	1.9	5.3	6.3
	Tosunbey	128	224	1.8	7.7	10.3	4.9	4.1	11.9
Vetch	Bayraktar 2000	69	55	2.2	2.9	5.5	3.9	3.7	4.1
	Eser	48	47	1.4	2.5	7.6	4.7	2.7	3.8
	Gerek 79	27	42	1.3	5.5	5.7	1.7	2.2	5.1
	Tosunbey	192	219	1.7	5.0	15.6	6.9	4.7	9.3

Winter Lentil	Bayraktar 2000	65	45	1.0	2.4	11.5	4.4	2.5	3.6
	Eser	52	62	1.6	1.8	7.0	7.3	3.0	3.4
	Gerek 79	30	60	1.5	1.5	5.5	9.7	2.4	3.3
	Tosunbey	127	242	1.4	6.8	12.5	5.9	3.5	11.5
Fallow	Bayraktar 2000	36	66	1.0	2.4	8.3	5.8	2.1	4.0
	Eser	25	40	1.2	2.5	5.2	3.4	1.9	3.2
	Gerek 79	29	57	2.9	2.3	2.5	6.3	3.2	4.0
	Tosunbey	137	231	1.3	6.8	13.6	5.5	3.4	11.2
Chickpea	Bayraktar 2000	61	104	1.0	1.7	11.0	11.6	2.4	4.0
	Eser	36	41	3.3	3.1	2.3	3.1	3.4	3.8
	Gerek 79	42	64	2.5	1.4	3.0	11.8	3.2	3.4
	Tosunbey	127	297	1.4	5.2	16.0	8.7	3.8	10.8
Spring Lentil	Bayraktar 2000	36	95	1.2	2.0	8.2	8.4	2.4	4.1
	Eser	12	84	1.5	1.4	1.7	11.7	1.4	3.3
	Gerek 79	19	35	3.3	5.6	1.7	1.5	3.0	4.8
	Tosunbey	39	267	2.1	7.1	8.5	5.9	4.4	12.2
Spring Oat	Bayraktar 2000	50	68	1.4	2.9	8.4	5.2	2.8	4.6
	Eser	19	60	3.1	4.1	2.2	3.0	3.3	5.0
	Gerek 79	20	79	2.6	1.6	2.4	11.6	2.8	3.9
	Tosunbey	80	335	1.4	4.3	11.9	10.9	3.5	9.9

3.2. Farinograph

Farinograph water absorption values ranged between 43-52% in the first year and 46-62% in the second year. In the first year, with 52% absorption value, Tosunbey after chickpea and sunflower, and Bayraktar 2000 varieties after fallow were the first and the lowest values were 43% with Eser after spring oat and Bayraktar 2000 after wheat. In the second year, Tosunbey variety showed the highest water absorption value after spring lentils, spring oats, chickpeas, wheat and safflower with 62% and the lowest value was measured in Eser cultivar with 46% after fallow. Softening value in the first year 14 BU-189 BU (Brabender Unit), the second year 10 BU-220 BU ranged between. In the first season, Eser variety gave the highest softening degree value after spring lentil with 189 BU and Tosunbey variety after sunflower had the lowest with 14 BU. In the second year, after the chickpea, Gerek 79 variety (220 BU) showed the highest softening value, Tosunbey variety was the lowest value with 10 BU after winter lentils. When we examine the development time of the Farinograph; it is seen that the values ranged between first year 0.7-3.4 m (minutes), second year 0.6-12.5 m In the first year Bayraktar 2000 variety after safflower shortest with 0.7 m, Eser showed the longest development period after wheat with 3.4 m. The second year; Bayraktar 2000 varieties after the fallow the shortest with 0.6 m and after sunflower Tosunbey variety gave the longest development time with 12.5 m In terms of evaluation Farinogaf stability; it is seen that the values ranged between first year 1.7-14.9 m and second year 1.8-22.0 m. First year, Gerek 79 variety after the chickpea the shortest with 1.7 m, after fallow Bayraktar 2000 variety showed the longest stability period with 14.9 m and second year, Gerek 79 variety after the spring oats the shortest with 1.8 m and Tosunbey variety after winter lentils were found to have the longest farinograph stability time with 22.0 m.

Table 2: Two years results of farinograph analysis on bread wheat cultivars sown after different fore crops

Fore crop	**Cultivar**	**Water**		**Softening value (BU)**		**Development Time**		**Stability**	
		1.	**2.**	**1. Year**	**2. Year**	**1. Year**	**2. Year**	**1. Year**	**2. Year**
Safflower	Bayraktar	44	53	104	40	0.7	3.7	4.2	12.0
	Eser	44	53	128	100	2.8	5.5	4.1	6.8
	Gerek 79	48	55	156	170	1.4	3.0	2.8	3.6
	Tosunbey	46	62	18	65	2.1	8.2	13.1	11.4
Wheat	Bayraktar	43	52	116	55	1.1	3.6	3.4	10.9
	Eser	46	52	135	105	3.4	8.2	3.2	6.6
	Gerek 79	45	55	142	190	1.7	3.1	2.5	3.6
	Tosunbey	48	62	25	60	2.3	8.3	5.4	10.6
Sunflower	Bayraktar	46	54	116	60	1.4	9.2	5.2	12.5
	Eser	45	53	180	120	1.6	6.6	3.7	5.2
	Gerek 79	47	57	161	180	1.1	3.0	4.1	3.6
	Tosunbey	52	61	14	60	2.5	12.5	13.5	8.7

Vetch	Bayraktar	48	53	70	40	0.8	2.3	4.7	9.9
	Eser	46	52	113	110	2.2	3.4	3.7	6.2
	Gerek 79	46	53	174	150	0.9	2.1	2.5	4.4
	Tosunbey	50	61	32	70	1.9	8.6	12.8	10.5
Winter Lentil	Bayraktar	47	53	90	55	2.9	3.3	4.2	6.0
	Eser	45	51	107	70	1.4	4.5	3.4	8.0
	Gerek 79	48	53	131	140	2.0	2.4	2.7	3.6
	Tosunbey	50	61	43	10	0.9	8.5	11.7	22.0
Fallow	Bayraktar	52	51	21	110	2.0	0.6	14.9	5.0
	Eser	45	46	98	80	2.0	4.9	2.9	7.0
	Gerek 79	47	53	106	150	1.2	1.0	3.3	3.0
	Tosunbey	50	61	31	20	2.9	10.1	10.9	21.0
Chickpea	Bayraktar	45	55	77	95	1.1	7.5	3.2	3.8
	Eser	45	53	96	120	1.4	3.5	4.4	4.9
	Gerek 79	47	55	117	220	1.2	2.2	1.7	3.0
	Tosunbey	52	62	55	170	1.8	10.5	7.2	8.6
Spring Lentil	Bayraktar	48	53	80	100	1.5	5.3	2.9	7.8
	Eser	45	51	189	70	0.9	4.4	2.7	5.8
	Gerek 79	49	54	58	210	1.5	2.5	2.2	2.5
	Tosunbey	49	62	54	90	1.5	10.5	14.5	8.9
Spring Oat	Bayraktar	47	53	89	90	1.0	3.6	2.3	7.6
	Eser	43	54	183	120	2.0	3.8	1.8	5.9
	Gerek 79	46	58	176	160	1.6	4.3	2.5	1.8
	Tosunbey	50	62	51	80	1.6	11.5	8.9	9.6

It is seen that the farinograms of Tosunbey and Bayraktar 2000 varieties were obtained from the wheat varieties planted after all fore crops gave strong graphs. Subsequently, Eser and Gerek 79 varieties gave different reactions after different forecrops (Figure 1). However, processing of very strong dough in bread making process is not preferred due to both difficult and increases the cost by the baker. In addition, the inner pore structure of breads belonging to very strong dough can not give the desired result. For this reason, it is appropriate to use such strong flours in bread making by blending them with weaker flours or to be used in strengthening weak flours.

In terms of farinograph parameters; cultivars reactions to fore crop applications were different. When farinograph water absorption, development time, softening degree and stability values are evaluated together with previous crop applications and years; in the first year, Tosunbey varieties had the best values in all other previous crop applications except Bayraktar-2000 variety and wheat previous crop after fallow. Second year; After vetch, Bayraktar-2000 variety and Tosunbey variety in all other forecrop applications except spring lentil showed the best performance, When farinograph values are evaluated in the first dry year and in the second year showing the amount and distribution suitable for rainfall; Bayraktar-2000 after Sunflower, safflower, vetch and fallow and Tosunbey varieties in all forecrop applications had the best values (Table 2). These have been reported that the rheological properties of the dough were affected by previous crops and it was found to be statistically significant [12] and the dough stability values measured by the farinograph analysis of wheat flour obtained from the plots continuously wheat planted were 28% less than the stability values obtained from bread wheat samples sown after winter rapeseed [13]. In this context, the findings obtained from the study are similar to researchers.

3.3. Bread Making

In breeding studies, it is aimed to develop varieties suitable for the final product quality and to prepare the appropriate agronomic package for this variety and to present them to the farmers. The kind of quality work done in this process is to determine which products will be processed. For this reason, it is important to make bread experiment in order to see the effect of pre-plant applications on the production of baked fermented bread. Conducted for two years and bread made in a laboratory bread units after physical, physico-chemical and the rheological analysis in wheat obtained after previous crop application, bread volumes were ranged between in first year of samples 150 to 380 ml adn second year 275-450 ml. In the second year, bread volumes were higher than the first year in parallel with the parameters of alvograph and farinograph. The first year, Tosunbey after safflower, wheat and fallow, Eser after sunflower, vetch, spring lentil and spring oats, Bayraktar 2000 after winter lentils and chickpeas after Gerek 79 varieties have reached the highest volume of bread, the second year Tosunbey gave highest bread volume in all forecrop applications except vetch (Table 3).

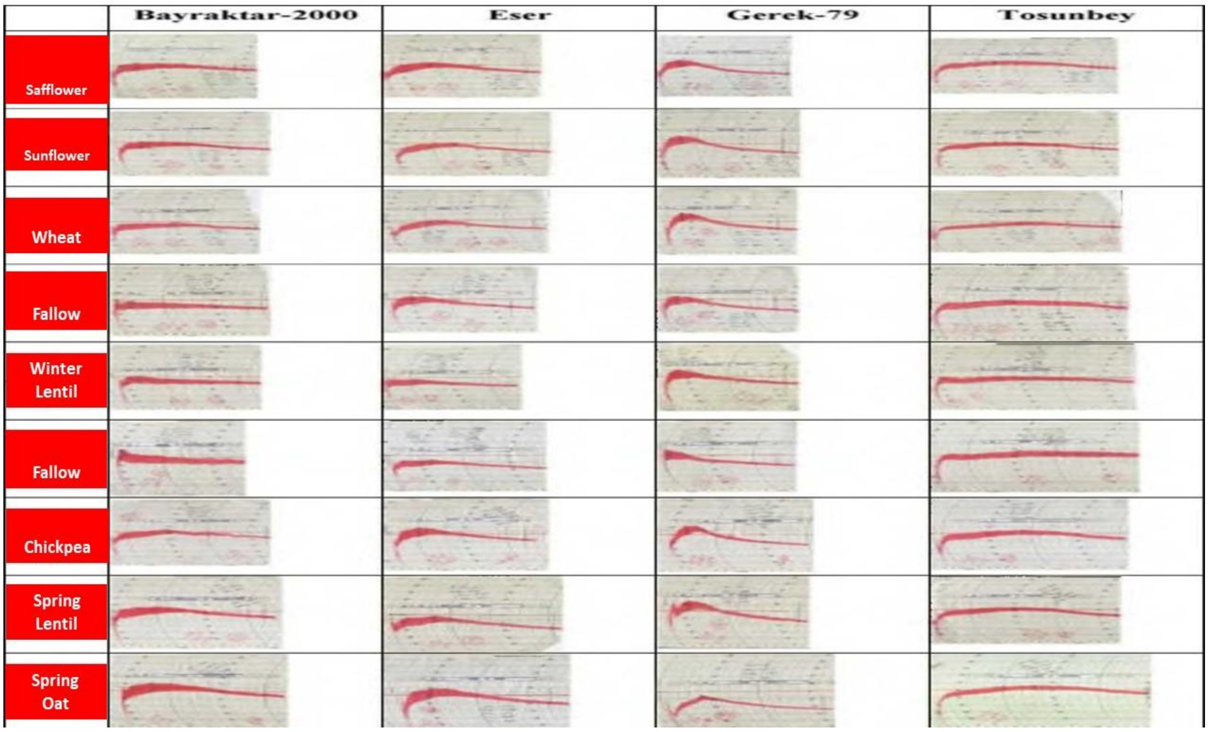


Figure 1: Farinograms of the second year samples

Table 3: Two years results of bread-making trials on bread wheat varieties sown after different forecrops

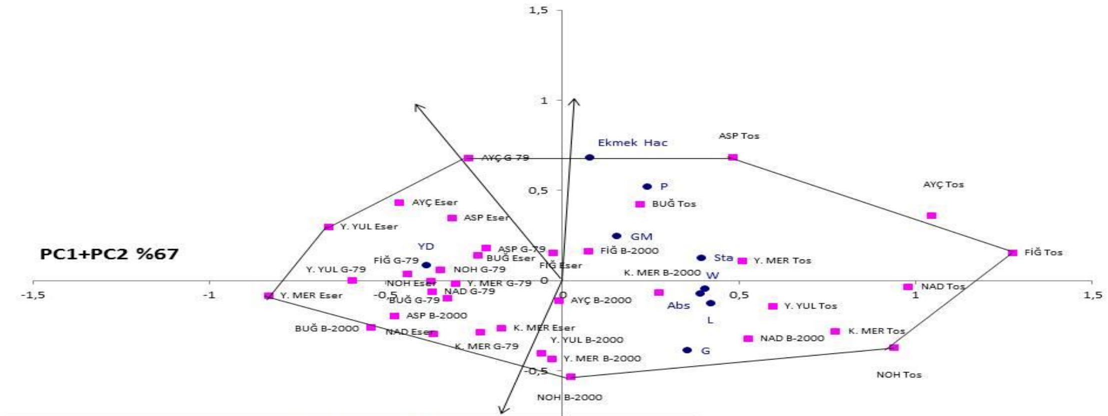
Fore crop	Cultivar	Bread Volume (ml) 1. Year	Forecrop	Cultivar	Bread Volume (ml) 2. Year
Safflower	Tosunbey	380	Sunflower	Tosunbey	450
Sunflowe	Eser	375	Wheat	Bayraktar	430
Sunflowe	Tosunbey	370	W. Lentil	Tosunbey	430
Sunflowe	Gerek 79	350	Wheat	Tosunbey	425
Safflower	Gerek 79	340	Fallow	Tosunbey	425
Vetch	Eser	340	Wheat	Eser	420
Vetch	Gerek 79	340	Safflower	Eser	410
Safflower	Eser	320	Safflower	Tosunbey	410
Vetch	Bayraktar	320	Chickpea	Tosunbey	410
Vetch	Tosunbey	320	S. Lentil	Tosunbey	395
W. Lentil	Bayraktar	280	Wheat	Gerek 79	380
S. Oat	Eser	270	Safflower	Gerek 79	375
Fallow	Tosunbey	260	Sunflower	Eser	375
S. Lentil	Eser	260	Vetch	Eser	370
Chickpea	Gerek 79	250	S. Lentil	Eser	365
Wheat	Tosunbey	240	Vetch	Gerek 79	360
S. Oat	Tosunbey	240	W. Lentil	Eser	360
S. Lentil	Tosunbey	230	Vetch	Tosunbey	350
Wheat	Gerek 79	225	Sunflower	Gerek 79	340
Wheat	Eser	210	Vetch	Bayraktar	340
W. Lentil	Tosunbey	210	Chickpea	Eser	340
Sunflowe	Bayraktar	200	S. Lentil	Bayraktar	340

S. Lentil	Gerek 79	200	Safflower	Bayraktar	330
S. Oat	Gerek 79	200	W. Lentil	Bayraktar	330
Safflower	Bayraktar	180	S. Oat	Gerek 79	330
Fallow	Bayraktar	180	S. Oat	Tosunbey	330
Fallow	Gerek 79	180	Chickpea	Bayraktar	325
Fallow	Eser	170	S. Oat	Bayraktar	325
Chickpea	Eser	170	W. Lentil	Gerek 79	320
Chickpea	Tosunbey	170	Chickpea	Gerek 79	310
Wheat	Bayraktar	165	S. Lentil	Gerek 79	310
W. Lentil	Eser	160	Sunflower	Bayraktar	300
S. Oat	Bayraktar	160	Fallow	Bayraktar	300
W. Lentil	Gerek 79	150	Fallow	Eser	300
Chickpea	Bayraktar	150	S. Oat	Eser	280
S. Lentil	Bayraktar	150	Fallow	Gerek 79	275

While the Tosunbey variety was found to have high values in all previous crop applications in bread making experiments, Eser variety, which became more prominent with its biscuit features, showed high bread values in many applications. Although Bayraktar 2000 and Gerek 79 showed good bread characteristics as a result of some previous crop applications, they had poor performance in general evaluation (Figure 2).

Figure 2: Breads made on the bread wheat varieties obtained from the parcels after the second year forecrops

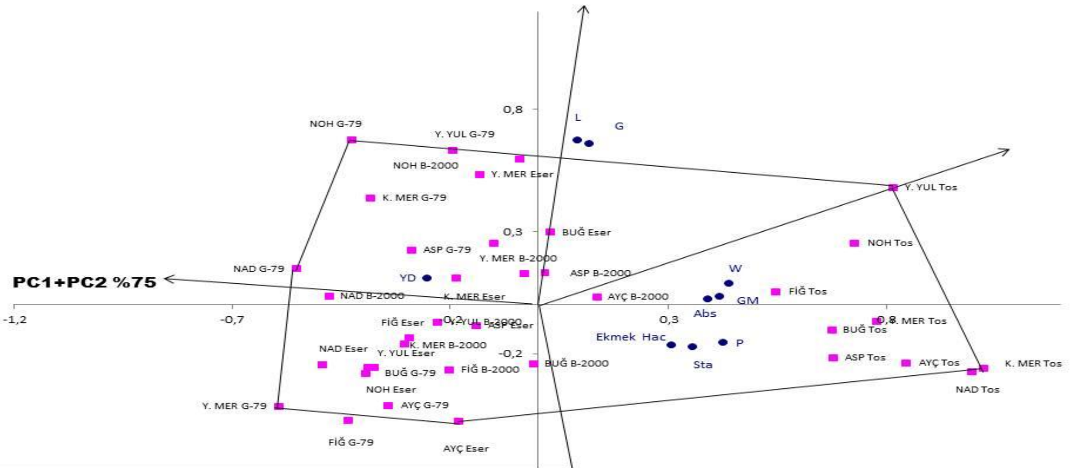
When the results are evaluated together; especially Tosunbey variety has been shown to give good results and it is seen that the genetic characteristics of the variety come forword. In both years wheat samples obtained from fore crop plots after sunflower and safflower also gave high quality parameters, in drought season, while fallow plots values are high in drought season, they have shown average values in good season. The data obtained from the previous crop plots planted in the dry season varies according to the varieties, although the fore crop species interaction is important in each parameter. Farinograph softening value (BU) was negative in both years and showed significant correlation with the other data at the 1st year $P < 0.01$ level, and at the second year with alveograph energy (W) and farinograph P value at $P < 0.05$ level. Bread volume was $P < 0.05$ with P value in the first year, positive with W, P, Abs (%), DT (d) and bread volume (ml) in the second year, and $P < 0.01$ with negative softening value (BU) and $P < 0.05$ level. These results also show that; There is a very close relationship between negative and positive quality parameters and these values are highly different according to agronomic practices, climate change and variety (Figure 3 and Figure 4).



1. Yıl Parametreler arası korelasyon tablosu									
	W	L	P	G	Abs%	YD	GM	Sta	Ekmek Hac
W	1	*0,756***	*0,429***	*0,759***	*0,639***	*-0,574***	0,158	*0,596***	0,175
L		1	0,318	*0,784***	*0,633***	*-0,717***	0,268	*0,675***	0,092
P			1	0,014	*0,374**	*-0,416**	0,16	*0,464***	*0,38**
G				1	*0,602***	*-0,477***	0,179	*0,461***	-0,104
Abs%					1	*-0,696***	0,199	*0,67***	0,05
YD						1	-0,222	*-0,743***	0,094
GM							1	0,229	0,203
Sta								1	0,224
Ekmek Hac									1

* %5, ** %1düzeyinde önemli

Figure 3: Biplot graph and correlation table for the first year rheology and bread making values



2. Yıl Parametreler arası korelasyon tablosu									
	W	L	P	G	Abs%	YD	GM	Sta	Ekmek Hac
W	1	0,278	*0,911***	0,318	*0,87***	*-0,371**	*0,858***	*0,604***	*0,474***
L		1	-0,063	*0,989***	0,16	-0,011	0,21	-0,04	-0,05
P			1	-0,024	*0,892***	*-0,347**	*0,799***	*0,632***	*0,555***
G				1	0,179	-0,094	0,244	0,037	-0,007
Abs%					1	-0,135	*0,703***	*0,443***	*0,487***
YD						1	*-0,443***	*-0,78***	*-0,34**
GM							1	*0,569***	*0,56***
Sta								1	*0,493***
Ekmek Hac									1

* %5, ** %1 anlamlı

Figure 4: Biplot graph and correlation table for the second year rheology and bread making values

4. Conclusion

The lack of sufficient rheological measurements in the flours of bread wheat varieties sown after the pre-plant was an obstacle for us to make adequate comparisons when evaluating our results. When the data is evaluated collectively; In our study, the amount of precipitation was low in the first year, precipitation distribution was not good and the temperature values were high. The combination of insufficient precipitation with temperature has led to significant reductions in both yield and quality. In the second year, the good amount of precipitation and distribution caused an increase in the yield and an increase in the quality. Non occuring expected quality increase with reduced yield can be explained by the dry and hot season of wheat during the grain filling period.

Among the rheological analyzes, the most important parameter of the alveograph analysis is the energy value, which shows great differences between the years. In the second year, the energy values gave very good values and the contribution of these values to the end product was high. Alveograph P/L values showed imbalance. Absorption values of the alveograph parameters, which are important in bread making, increased in the second year, and the softening values required to be low according to the varieties and applications showed changes. In the second year of development time, parallel to quality increases, stability values were found to be better.

The volume of bread, the final product, was higher in the second year than in the first year. Bread volume was parallel to alveograph and farinograph parameters determining dough characteristics. In the second year, especially Tosunbey variety gave the highest bread volume in almost all applications. Eser variety, which is mostly considered as biscuit, showed very good bread volume values in the second year when the climate values were suitable and showed that it could be used as bread bread in the years that went well and could be used in blending.

In this study carried out for two years, it was determined that Tosunbey variety gave the best values in bread, which is the end product, with different quality values in different dry plants in dry and rainy years. It is stated that dominant plants such as safflower and sunflower as well as legumes regulate the use of water and nutrients due to the suppression of weed population in the field and have good values; It is understood that it can be evaluated in rotation systems in dry conditions of Central Anatolia. In addition to the prominent genetic characteristics of the variety, it was found that the effect of previous crops on bread wheat quality was significant.

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