International Journal of Applied Biology and Environmental Sciences
E-ISSN: 2667-6540 6(2): 18-24, 2024
Doi: 10.5505/ijabes.2024.32032
Research Article

DETERMINING SEED CLASSIFICATION BY CONTACT ANGLE METHOD IN BREAD WHEAT (*Triticum aestivum* L.)

Murat OLGUN[1]

[1] Field Crop Department, Agricultural Faculty, Eskişehir Osmangazi University, Eskişehir, Turkey

Orcid:0000-0001-6981-4545

Corresponding author

muratolgun2626@gmail.com

Abstract: The aim of this to determine wheat genotype class by contact angle method. In study, a healthy classification of the varieties was made by utilizing the contact angle created by water with the seed, and the usability of the contact angle technique in the classification of wheat varieties was investigated. In this study, bread wheat genotypes (Müfitbey, Tosunbey, Yunus, Nacibey, Es26, Reis, Sönmez, Altay, Ahmetağa, Rumeli, Bezostaja and Alpu) were used. As a result, PCA and BiPlot analyses revealed that the Nacibey, Rumeli, Es26, Altay, Reis, Bezostaja and Sönmez genotypes have the most suitable similarity angle, especially in terms of contact angle feature. BipPlot analysis gives successful results in contact angle analysis. Again, contact angle analysis can be used safely in the classification of wheat genotypes.

Keywords: Bread wheat, contact angle, genotype classification, PCA and Biplot analyses.

Özet: Bu çalışmanın amacı buğday genotip sınıfını temas açısı yöntemi ile belirlemektir. Çalışmada, suyun tohumla oluşturduğu temas açısından faydalanılarak çeşitlerin sağlıklı bir sınıflandırması yapılmış ve temas açısı tekniğinin buğday çeşitlerinin sınıflandırılmasında kullanılabilirliği araştırılmıştır. Bu çalışmada; ekmeklik buğday genotipleri (Müfitbey, Tosunbey, Yunus, Nacibey, Es26, Reis, Sönmez, Altay, Ahmetağa, Rumeli, Bezostaja ve Alpu) kullanılmıştır. Sonuç olarak, PCA ve BiPlot analizleri Nacibey, Rumeli, Es26, Altay, Reis, Bezostaja ve Sönmez genotiplerinin özellikle temas açısı özelliği bakımından en uygun benzerlik açısına sahip olduğunu ortaya koymuştur. BipPlot analizi temas açısı analizinde başarılı sonuçlar vermektedir. Yine temas açısı analizi buğday genotiplerinin sınıflandırılmasında güvenle kullanılabilir.

Keywords: Ekmeklik buğday, temas açısı, çeşitlerin sınıflandırması, PCA ve Biplot analizleri.

INTRODUCTION

Wheat (Triticum aestivum L. is the second most cultivated grain worldwide, along with corn. Wheat ranks first in terms of cultivation and production among cultivated plants used in human nutrition. This is because the wheat plant has a wide adaptability. In addition, wheat grain is the staple food of many countries due to its suitable nutritional value, ease of storage and processing. Wheat provides approximately 20% of the total calories provided by plant-based foods to the world population (Babaoğlu and Öztürk, 1996; Anon., 2004; Atay, 2006). Wheat is used in many food and industrial sectors, especially bakery products. Wheat has been the most important foodstuff for people in almost every era. The fact that it contains starch and protein substances necessary for nutrition in a very suitable ratio has caused this plant to take the first place in agriculture. In order to meet the food needs of the ever-increasing world population and to ensure regular nutrition, plant production, especially grain production, needs to be increased. Since the last century, irrigation, fertilization, spraying and the development of new high-yielding genotypes have increased productivity. In this increase, especially the use of chemical fertilizers and the development of short-statured, lodging-resistant genotypes in wheat, and the use of pesticides against diseases and pests have provided a 2-fold increase in yield (Anon., 2004; Atalık, 2007; Akar et al., 2016). Regular production of wheat, which is so important in terms of nutrition, is only possible with the use of registered genotypes. The use of genotypes required for high production is only possible with pure production without mixing the genotypes. Here, knowing the characteristics of the genotypes and determining their physical and chemical properties are important in terms of preventing genotype confusion. Clear methods are used in the separation and classification of genotypes. Modern methods developed in recent years are used in making this separation and these methods yield successful results (Pierce et al., 2008; Korhonen et al., 2013; Aydar and Bağdatlıoğlu, 2014). One of these methods is the use of the contact angle created by the grain with water. The contact angle is a basic measurement that quantifies the angle at which a liquid droplet comes into contact with a solid surface (Anon., 2024). The contact angle reveals the basic material properties that indicate wettability and direct the optimization of the seed surface. In addition, it can contribute to the classification of genotypes by defining surfaces in agriculture. In this study, a healthy classification of the genotypes was made by utilizing the contact angle created by water with the seed, and the usability of the contact angle technique in the classification of wheat genotypes was investigated.

MATERİALS AND METHODS

In this study, bread wheat genotypes (Müfitbey, Tosunbey, Yunus, Nacibey, Es26, Reis, Sönmez, Altay, Ahmetağa, Rumeli, Bezostaja and Alpu) used. The characteristics of the bread wheat genotypes used are given below. **Müfitbey**: white and awned spike, white hard grain, 110-115 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 12-13%, thousand grain weight 39-42 gr, test weight 79-81 kg/hl, yield 5-7 t/ha, resistant to black rust, brown rust and yellow rust. **Tosunbey**: white and awned spike, white hard grain, 90-100 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 12-13%, thousand grain weight 37-40 gr, test weight 78-80 kg/hl, yield 5-6 t/ha, resistant to yellow rust. **Yunus**: white and awnless spike, white hard grain, 105-110 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 11-13%, thousand grain weight 36-42 gr, test weight 79-81 kg/hl, yield 5-6 t/ha, resistant to black rust, brown rust and yellow rust. **Nacibey**: white and awned spike, white semi-hard grain, 100-105 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 10-12%, thousand grain weight 36-38 gr, test weight 77-79 kg/hl, yield 4-5,5 t/ha, resistant to black rust, brown rust and yellow rust. **Es26**: brown and awned spike, white soft grain, 110-115 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 10-12%, thousand grain weight 37-40 gr, test weight 77-79 kg/hl, yield 4-5 t/ha, resistant to black rust, brown rust and yellow rust. **Reis**: brown and awned spike, red hard grain, 95-100 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 13-14%, thousand grain weight 38-40 gr, test weight 79-80 kg/hl, yield 4-6 t/ha, resistant to black rust, brown rust and yellow rust. **Sönmez:** white and awnless spike, red hard grain, 100-110 cm plant height, winter habit, resistant to drought, cold and lodging, protein content 11-13%, thousand grain weight 37-38 gr, test weight 80-82 kg/hl, yield 4,5-6 t/ha, resistant to black rust, brown rust and yellow rust. **Altay:** brown and awned spike, white semi-hard grain, 100-105 cm plant height, winter habit, resistant to drought, cold and lodging, protein content 12-14%, thousand grain weight 37-42 gr, test weight 80-81 kg/hl, yield 4-5 t/ha, resistant to black rust, brown rust and yellow rust. **Ahmetağa:** white and awned spike, red hard grain, 90-100 cm plant height, winter habit, resistant to drought, cold and lodging, protein content 12-13%, thousand grain weight 37-39 gr, test weight 77-80 kg/hl, yield 5-6 t/ha, resistant to black rust, brown rust and yellow rust. **Rumeli**: white and awned spike, red hard grain, 100-110 cm plant height, winter habit, resistant to drought, resistant to cold and lodging, protein content 13-14%, thousand grain weight 42-44 gr, test weight 81-82 kg/hl, yield 5-7 t/ha, resistant to black rust, brown rust and yellow rust. **Bezostaja:** white and awnless spike, red hard grain, 90-1000 cm plant height, winter habit, resistant to drought, cold and lodging, protein content 13-15%, thousand grain weight 40-43gr, test weight 81-83 kg/hl, yield 4-7 t/ha, resistant to black rust, brown rust and yellow rust. **Alpu:** white and awned spike, white semi-hard grain, 90-100 cm plant height, winter habit, resistant to drought, cold and lodging, protein content 10-12%, thousand grain weight 39-42 gr, test weight 80-82 kg/hl, yield 5-6 t/ha, resistant to black rust, brown rust and yellow rust.

The contact angle measuring device automatically analyses the drop shape over time by recording drop images. The drop shape is a function of the surface tension of the liquid, the density difference between the liquid and the surrounding medium. On solid surfaces, the drop shape and contact angle depend on the free surface energy of the solid. Measurements of contact angle, surface tension, interfacial tension and surface free energy provide information on surface properties such as wettability, liquid absorption, liquid adsorption, liquid spreading, surface cleanliness, surface heterogeneity, emulsion stability, etc. Contact angle is important wherever the intensity of phase contact between liquids and solids needs to be controlled or evaluated (Kwok and Neumann, 1999; Anon., 2024). Contact angle values of wheat seeds were measured with the Attension Theta Optical Tensiometer and the explanation of contact angle values is shown in Figure 1.

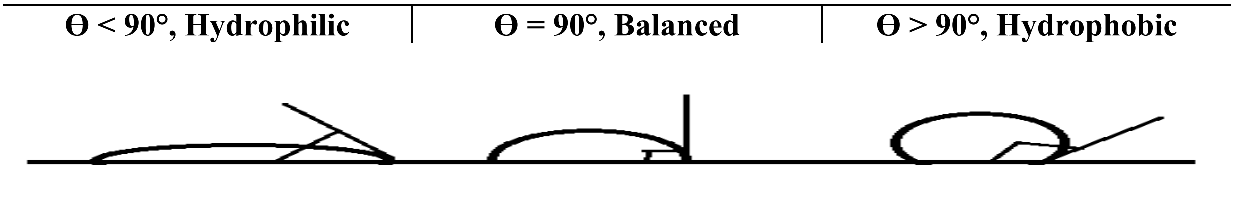


Figure 1. Explanation of contact angle values.

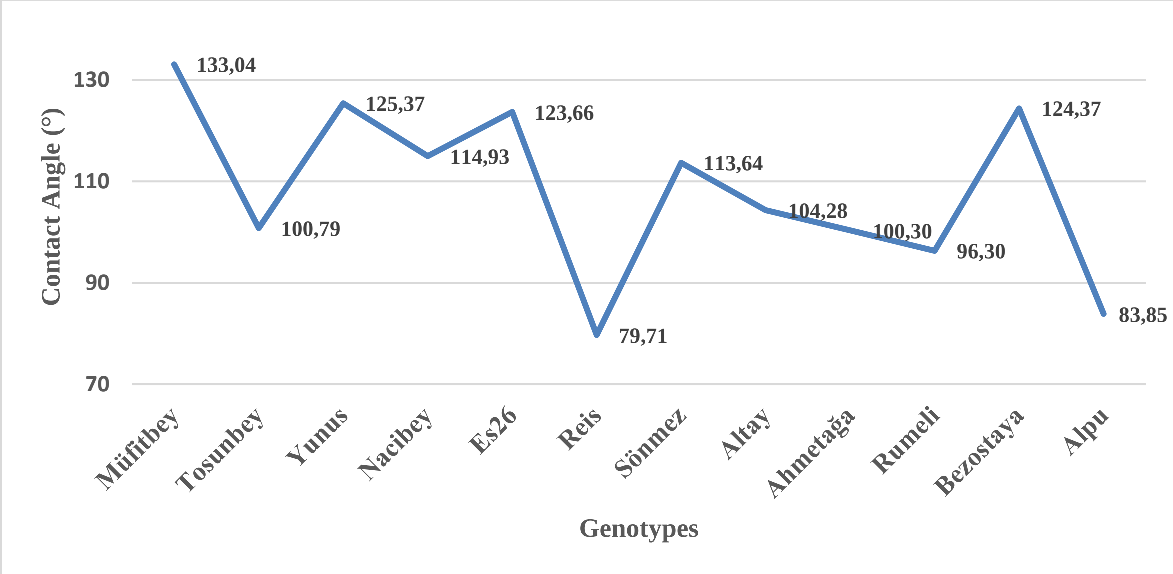
The water contact angle will give an immediate indication of the wettability of the solid. If the measured contact angle is above 90° degrees, the solid is said to be poorly wetting and is called hydrophobic. If the contact angle is below 90°, the term hydrophilic is used. If the contact angle is greater than 90° – hydrophobic, if less than 90° – hydrophilic, if equal to 90° – it is considered balanced and allows the classification of seeds based on the difference in degrees (Kwok and Neumann, 1999; Anon., 2024).

RESULTS AND DISCUSSION

In wheat, regular and healthy production should be done for the high yielding and quality genotypes used in order to make a healthy production. In this respect, it is necessary to recognize the genotypes in healthy production and to ensure their pure production. The techniques developed to protect the purity of the variety require the determination of the physical and chemical properties of the variety. Although there are various techniques in this regard, many new methods are being tried in order to get to know the variety better. In this respect, the contact angle technique is a method to be used in wheat identification. In this context, the average contact angle values, minimum and maximum values determined for the genotypes using the contact angle are given in Table 2. As can be seen from the table, the contact angles of the genotypes varied between 79.712° degrees and 133.04°. This shows that there are significant differences between the contact angles of the genotypes. When we look at their standard sales, this variation is clearly seen. The fact that the standard deviation varies so much indicates that the physical properties of the genotypes, the outer surface structure of the seed have different properties and that they form differently in the spatial plane.

Tablo 2. Mean, standard deviation, maximum and minimum values of the genotypes.

Genotypes	Mean	StDev	Minimum	Maximum	Genotypes	Mean	StDev	Minimum	Maximum
Müfitbey	133,04	0,437	132,1	134,17	**Sönmez**	113,64	0,109	113,38	113,92
Tosunbey	100,79	0,169	100,44	101,28	**Altay**	104,28	0,319	103,56	104,96
Yunus	125,37	1,04	123,04	127,88	**Ahmetağa**	100,30	0,759	98,95	100,96
Nacibey	114,93	0,164	114,57	115,33	**Rumeli**	96,296	1,609	93,255	100,455
Es26	123,66	1,41	121,50	125,81	**Bezostaja**	124,37	0,275	123,39	124,79
Reis	79,712	0,144	78,993	80,027	**Alpu**	83,854	1,744	80,484	87,924

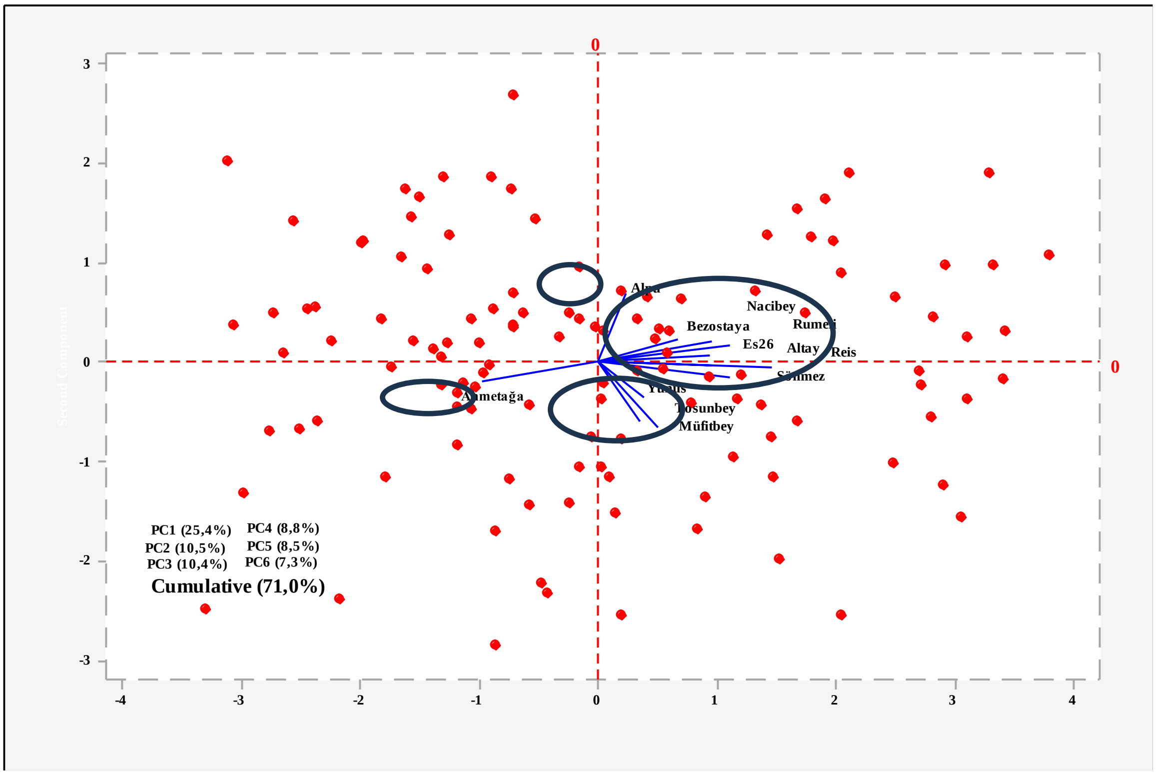


In data science studies, it may be necessary to work with a large number of variables. The prepared models will need to work with optimum performance in optimum time. Principal component analysis (PCA) is a method of finding the projection of a data in a high-dimensional space to a lower-dimensional space in a way that maximizes variance. Principal component analysis (PCA) is a dimensionality reduction method used to simplify a large data set into a smaller set while preserving important patterns and trends. In the PCA method, variable selection and dimensionality reduction methods can be used. In variable selection, the variable in the data set is preserved or completely removed. In dimensionality reduction, the number of variables is reduced by creating new variables consisting of a combination of existing variables. Thus, all the features in the data set are still present in some way, but the number of variables is reduced (Wold et al., 1987; Auer and Gervini, 2008; Bro and Smilde, 2014; Choi et al., 2017). The principal component analysis and Biplot analysis conducted to investigate the effect of contact angle on wheat genotypes are given in Table 3. The effect of contact angle and the similarity and difference between wheat genotypes, in other words, the effects of proximity and distance, were only determined safely at the PC_6 stage.

Table 3. Principal component analysis made on the effect of contact angle on wheat genotypes.

	PC_1	PC_2	PC_3	PC_4	PC_5	PC_6
Eigenvalue	3,047	1,262	1,251	1,060	1,023	0,878
Proportion	0,254	0,105	0,104	0,088	0,085	0,073
Cumulative	0,254	0,359	0,463	0,552	0,637	0,71
	PC_1	**PC_2**	**PC_3**	**PC_4**	**PC_5**	**PC_6**
Müfitbey	0,118	-0,48	-0,356	0,439	-0,345	-0,145
Tosunbey	0,168	-0,513	0,024	0,068	0,652	0,074
Yunus	0,125	-0,277	-0,27	-0,704	0,05	0,005
Nacibey	0,313	0,172	0,372	0,113	-0,151	-0,114
Es26	0,312	-0,024	0,208	-0,205	0,228	-0,445
Reis	0,312	0,048	-0,419	0,218	0,035	0,279
Sönmez	0,363	-0,123	0,344	-0,007	-0,005	0,406
Altay	0,478	-0,038	0,004	0,192	-0,004	0,082
Ahmetağa	0,219	0,178	-0,418	-0,337	-0,211	0,181
Rumeli	0,366	0,133	0,19	-0,148	-0,262	0,183

Bezostaja	0,078	0,556	-0,274	0,175	0,514	0,108
Alpu	-0,318	-0,148	0,196	-0,032	0,013	0,66



While the greatest effect was revealed at the PC_1 level, this effect gradually decreased at the other stages till PC_6. When the BiPlot analysis was examined, 4 different groups were seen when we looked at it. While the Nacibey, Rumeli, Bezostaja, Es26 Altay, Sönmez and Reis genotypes formed one group; Tosunbey, Müfitbey and Yunus genotypes formed another group. Ahmet and Alpu genotypes formed separate groups per check. As a result, PCA and BiPlot analyses revealed that the Nacibey, Rumeli, Es26, Altay, Reis, Bezostaja and Sönmez genotypes have the most suitable similarity angle, especially in terms of contact angle feature. BipPlot analysis gives successful results in contact angle analysis. Again, contact angle analysis could be used safely in the classification of wheat genotypes.

REFERENCES

[1]. Akar, T., Bağcı S.A., Köksel, H., Eser V., 2016, Unrealistic Claims About Wheat in Our Country and Around the World. Türktob, 17: 4-7.

[2]. Anonymous, 2004, Cereal Report in 2004. Turkısh Gtain Board, Ankara.

[3]. Anonymous, 2024, https:// innovativechemistryjournal.com/wettingabilitiesandcontactangleof liquids.

[4]. Atalık, A., 2007, The Relationship Between the Historical Process of Agriculture and Food Security. Sugar World, 28: 48-51.

[5]. Atay, A.T., 2006, History of Turkish Seed Improvement. Journal of Agriculture and Engineering, 78-79: 45-52.

[6]. Auer, P., Gervini, D., 2008, Choosing principal components: a graphical method based on Bayesian model selection. Commun. Stat. Simul. C., 37: 962–977.

[7]. Aydar, A.Y., Bağdatlıoğlu N., 2014, Methods Applied to Determine Surface Tension and Contact Angles of Edible Oils. Academic Food, 12(1): 108-114.

[8]. Babaoğlu, M., Öztürk, İ., 1996, Wheat Researches in the Thrace Region of Turkey. AWN 42: 202-203. http://www.wheat.pw.usda.gov./ggpage/awn/42/awn42d4.html.

[9]. Bro, R., Smilde, A.K., 2014, Principal component analysis. Anal. Methods 6: 2812—2831.

[10]. Choi, Y., Taylor, J., Tibshirani, R., 2017, Selecting the number of principal components: Estimation of the true rank of a noisy matrix. Ann. Stat: 259—2617.

[11]. Korhonen, J.T., Huhtamaki, T., Ikkala, O., Ras, R.H.A., 2013, Reliable Measurement of the Receding Contact Angle, Langmuir, 29 (12): 3858-3863.

[12]. Kwok, D.Y., Neumann, A.W., 1999, Contact angle measurement and contact angle interpretation. Advances in Colloid and Interface Science, 81(3): 167–249.

[13]. Pierce, E., Carmona, F.J., Amirfazli, A., 2008, Understanding of Sliding and Contact Angle Results in Tilted Plate Experiments. Colloids Surf. Physicochem. Eng. Asp., 323 (1–3), 73–82.

[14]. Wold, S., Esbensen, K., Geladi, P., 1987, Principal component analysis. Chemometr. Intell. Lab. Syst. 2: 37–52.