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Research Article

Usability of Decision Tree Analysis in Bread Wheat (*Triticum aestivum* L.) Breeding

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Abstract

The purpose of this study to determine the effective yield components on seed yield by of biplot and decision tree analyses. As a results of biplot and decision tree analyses, the most effective yield components were determined as SPAD, spike number/m2 and seed number/spike components on grain yield. Müfitbey and Rumeli genotypes were determined as high performance and quality genotypes.

Keywords: Bread wheat, genotype, biplot and decision tree analyses, yield components.

Özet

Bu çalışmanın amacı tohum verimine etkili verim bileşenlerini biplot ve karar ağacı analizleriyle belirlemektir. Sonuç olarak, SPAD ve desicion tree analizi sonucunda en etkin verim unsurları spike number/m^2 ve seed number/spike unsurları, tane verimi üzerinde en etkin unsurlar olarak belirlenmiştir. Müfitbey ve Rumeli çeşitleri yüksek performanslı ve kaliteli çeşitler olarak belirlenmiştir.

Anahtar Kelimeler: Ekmeklik buğday, genotip, biplot ve karar ağacı analizleri, verim unsurları.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the oldest cultivated plants in the world, and Anatolia is one of the most important regions where wheat is the homeland. The annual world grain production of wheat is about 2,5 billion tons, of which approximately 700 million tons is wheat. In Turkey, wheat is produced in 1/3 of the agricultural areas (approximately 8 million ha), and approximately 20 million tons are produced (Anon., 2019). Due to the high nutritional value of its grain, ease of transportation, storage, processing and wide adaptability, it is the basic food of many countries today. As the basic food of approximately 35% of the world's population, wheat provides 20% of the calories taken from food in the world (Kün, 1983; Kün et.al., 1994; Anon., 2004).

One of the most important factors in increasing the yield of wheat in breeding studies carried out on wheat is possible by fully implementing the cultivation techniques. With the increase in the inadequacy in plant production arising from the increase in our population, the necessity of increasing production has emerged. In order to increase plant production, it is necessary to expand the cultivation areas or to increase the yield of the product obtained from the unit area. Since the current cultivation areas in our country are at their upper limit, increasing the productivity per unit area is seen as a solution. The increase in productivity per unit area is affected by ecology, genotype and cultivation techniques (fertilization, irrigation, planting methods etc.). In many studies, it has been shown that progress in wheat yield is achieved by; coolness in the plant cover, determined speed in photosynthesis, conductivity and chlorophyll content seen in stomata etc. They explained that many physiological traits are used as a selection criterion in wheat breeding (Austin et al, 1980; Austin, 1982; Ashraf and Bashir, 2003). Increasing production in wheat is possible by developing and spreading the use of high yielding and high quality, drought, heat, disease and pest resistant and stable genotypes in breeding programs, as well as other applications. In these studies, it is important to determine the yield factors that are effective on yield. For this purpose, many statistical methods are used. In this study, biplot and decision tree analyses were used to determine the yield factors that are effective on grain yield in bread wheat.

MATERIALS AND METHODS

This research was carried out in 2021-2022 in the experimental area of Eskişehir Osmangazi University Faculty of Agriculture under irrigated conditions. In the 2021-2022 total precipitation and average temperature were 369,6 mm and 9,2 °C. Soils in the experimental area were salt-free, 1,8% organic matter and 5,32% lime, and are clayey loamy and slightly alkaline in structure. Sowing was done on 15 October with a plot drill and the sowing density was applied as 0,24 t/ha. In the experiment, 0,06 t/ha N and 0,06 t/ha P_2O_5 were applied to the wheat genotypes as base fertilization together with sowing. Altay, Bayraktar, Sönmez, Ahmetağa, Yunus, Rumeli and Müfitbey genotypes were used. Components: seed yield, seed number/spike, spike number/m^2, seed weight/spike, thousand seed weight, test weight, protein content and micro sedimentation were evaluated. Biplot and decision tree diagram analyses of the average data obtained from the genotypes were performed using Minitab 17, and SPSS 26 software programs.

RESULTS AND DISCUSSION

It is accepted by everyone that wheat is a very important plant in terms of food in the world. The food demand required by the rapid population growth in the world can only be met by

sufficient production of certain products and by increasing their production rapidly. Increasing the production of wheat, one of these products, will only be possible by introducing high-yield and high-quality genotypes into production (Atlı, 1986). In order to achieve this, effective yield components should be determined and used effectively in breeding programs. The mean, maximum and minimum values of the examined yield components of wheat genotypes are given in Table 1.

Table 1. Mean, maximum and minimum values of the efficiency components examined.

Variable	Mean	Minimum	Maximum	Variable	Mean	Minimum	Maximum
Seed Yield	542,16±20,42	459,57	610.34	**Test Weight**	78,39±0,84	73,12	78,68
Seed Num./Spike	33,52±1,74	30,91	43,36	**Protein Content**	12,74±0,27	11,89	14,22
Spike Num./m^2	311,57±10,72	271,47	349,05	**Micro Sedim.**	12,68±0,28	13,822	16,11
Seed We/Spike	1,39±0,04	1,12	1,44	**SPAD**	53,73±2,13	43,71	59,73
Thou. Seed We.	34,47±1,46	27,46	37,31				

Biplot analysis is an effective method for explaining the components under study, and by combining the relationship and performance of the components under study in two basic directions on the same graph, it allows the researcher to visually evaluate the data in two ways (Yan, 2001; Yan, 2002). The decision tree procedure creates a tree-based classification model. It divides the cases into groups or estimates the values of the dependent variable based on the values of the independent variables. The procedure provides validation tools for exploratory and confirmatory classification analysis. A decision tree is a flowchart-like diagram that maps all potential solutions to a given problem. It is often used by organizations to help determine the most appropriate course of action by comparing all possible outcomes of a series of decisions (Zhang, 1995; Loh and Shih, 1997; Li et al., 2012). The biplot analysis showing the performance of wheat genotypes and the component under study is given in Figure 1. As can be seen from the figure, wheat genotypes are divided into three groups, and the components under study are divided into three groups. Rumeli and Müfitbey were in the same group. Sönmez, Ahmetağa, Bayraktar and Yunus genotypes were in one group. Altay genotype was in one group. The examined components were in three groups. Protein content was in a single and separate group. Thousand seed weight, spike number/m^2, micro sedimentation, test weight was in the same group. Seed weight/spike, seed number/spike, spad and seed yield were in another group. According to this analysis, Müfitbey and Rumeli genotypes were determined as high performance and quality genotypes. SPAD, Seed weight/spike, seed number/spike, spad, spike number/m^2, micro sedimentation and test weight were determined to be effective factors that have a close relationship with grain yield and quality. Desicion tree analysis is given in Figure 2. As can be seen from the figure, SPAD was determined as the most effective component on grain yield. In the case where SPAD is lower than 53, SPAD was determined as the most

effective component on grain yield. As can be seen from the figure, SPAD was determined as the most effective component on grain yield. When SPAD is lower than 53, spike number/m^2 affects grain yield (R^2: 78%).

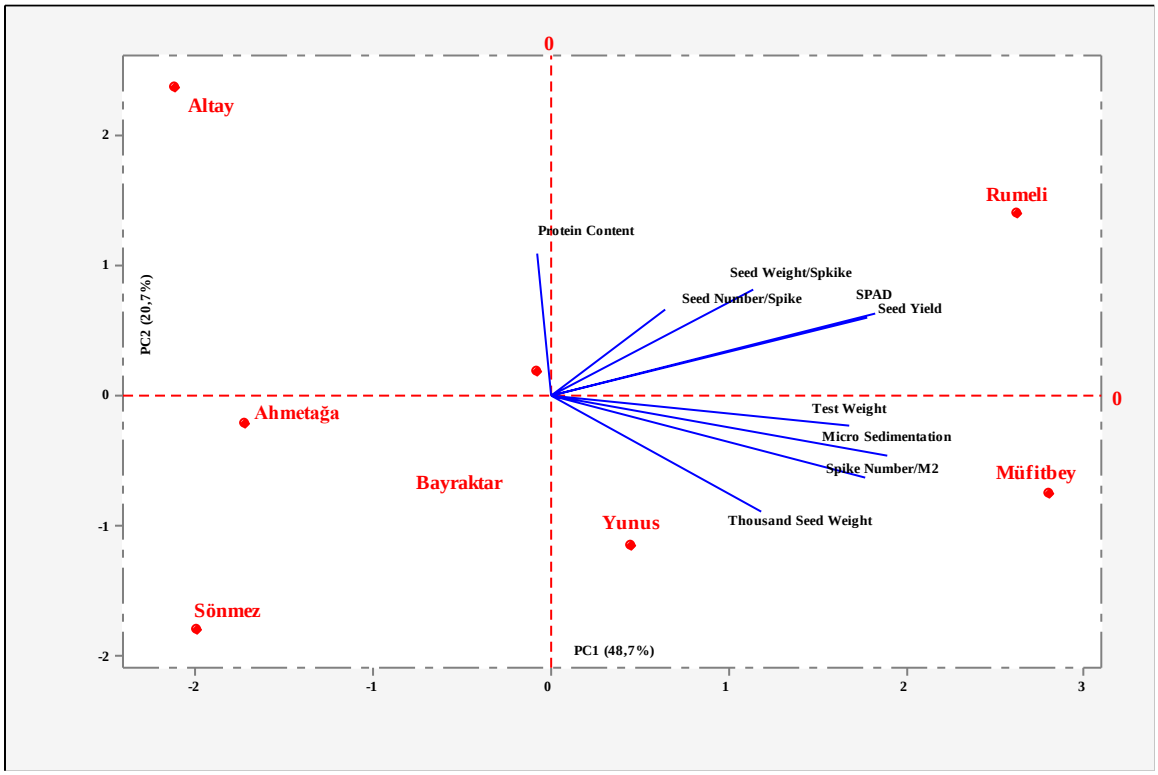
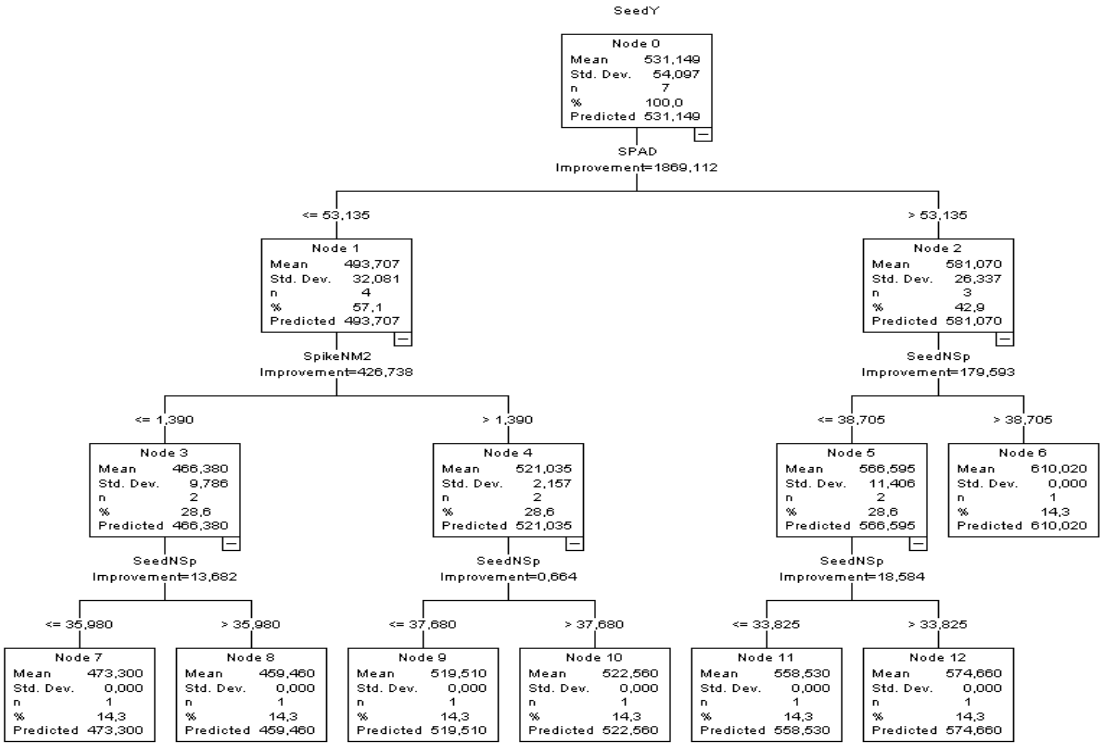


Figure 1. Mean, maximum and minimum values of the efficiency components examined.



R^2: $\frac{Risk\ Estimation}{\delta^2}$: $\frac{2282,6}{2926,4}$: 0,78

Figure 2. Desicion tree analysis showing effective yield components on seed yield.

Depending on the spike number/m^2 component, the seed number/spike component is also effective. Depending on the decrease or increase of the spike number/m^2 component, the seed number/spike component also increases or increases. In the case where SPAD is greater than 53, seed number/spike shows itself as the most effective yield component. As a result, because of SPAD and desicion tree analysis, the most effective yield components, spike number/m^2 and seed number/spike components, were determined as the most effective components on grain yield. Müfitbey and Rumeli genotypes were determined as high-performance and quality genotypes.

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