IJABES

International Journal of Applied Biology and Environmental Sciences
E-ISSN: 2667-6540 6(2): 38-43, 2024
Doi: 10.5505/ijabes.2024.24633
Research Article

Determining effective yield components on seed yield by Path and Biplot Analyses in Bread Wheat (*Triticum aestivum* L.)

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Abstract: The purpose of this study was to determine the effective yield factors (plant height, spike number/m^2, spike height, spikelet number, seed number/spike, seed weight/spike, 1000 seed weight, test weight, harvest index and protein content) on grain yield in bread wheat genotypes by statistical methods. Results denoted that spike number/m^2, seed number/spike, seed weight/spike and test weight are important components; Müfitbey, Altay, Nacibey, Es 26 were high potential and stabile genotypes.

Keywords: Bread wheat, genotype, path and biplot analyses, effectiveness, yield components.

Özet: Bu çalışmanın amacı, ekmeklik buğday genotiplerinde tane verimi üzerinde etkili olan verim faktörlerinin (bitki boyu, başak sayısı/m^2, başak yüksekliği, başakçık sayısı, tohum sayısı/başak, tohum ağırlığı/başak, 1000 tohum ağırlığı, tohum ağırlığı, hasat indeksi ve protein içeriği) istatistiksel yöntemlerle belirlenmesidir. Sonuçlara göre, başak sayısı/m2, tohum sayısı/başak, tohum ağırlığı/başak ve tohum ağırlığı önemli bileşenlerdir; Müfitbey, Altay, Nacibey, Es 26 genotipleri yüksek potansiyelli ve stabildir.

Anahtar Kelimeler: Ekmeklik buğday, genotip, path ve biplot analizleri, etkinlik, verim unsurları.

INTRODUCTION

Wheat is a cultivated plant of great importance in human nutrition and has the widest adaptation ability among cereals. Wheat flour, which is grown in more than a hundred countries in the world, is used as a raw material in the production of many products in many cultures and geographies due to its unique structure (Atlı,1992). Again, wheat is the most cultivated plant in the world, together with corn, in terms of planting area and production (Anon., 2019). In Türkiye, wheat ranks first among cereals with approximately 8 million hectares of acreage, approximately 20 million tons of production and 2,44 t/ha yield (Anon., 2010). Wheat, which is the basic food of approximately 35% of the world's population, provides 20% of the calories taken from food all over the world. 53% of daily calorie consumption in Turkey is provided by wheat (Kün, 1983). Wheat is the staple food of approximately 35% of the world's population due to its good nutritional raw material, wide adaptation limit, ease of production, transportation, storage and processing (Kün, 1988; Yang and Baker, 1991; Tripathi et al., 2003; Yanbeyi and Sezer, 2006).

Due to the increasing human population, the need for grain is also increasing for people and animals to be sufficiently nourished. However, due to reasons such as erosion, natural disasters, unplanned urbanization, etc., agricultural areas are gradually decreasing. Due to the increasing food need and decreasing agricultural areas, we need to increase the agricultural products obtained from a unit area for people to have sufficient and balanced nutrition. Increasing wheat production in the world is only possible by developing and introducing production genotypes that are high yielding, high quality, resistant to biotic and abiotic stresses, and stable in terms of these features. In developing genotypes in terms of these features, it is possible by carrying out the breeding studies carried out effectively and continuously. The effective execution of breeding studies can only be revealed by determining the yield components affecting high yield, and effective studies in the field of breeding and agronomy (happening literature). In many studies conducted on wheat in the world, yield components affecting yield have been determined (Ryan et al., 1991; Prystupa et al., 2003). In many studies, it has been determined that the factors such as number of spikes per square meter, number and weight of grains per spike, harvest index, test weight are quite effective on yield (Mehrotra et al., 1967; Tripathi et al., 2003). By determining the effect levels of such yield factors, more effective progress will be made in wet and argonomy programs and high quality and high yield genotypes will be developed (Prystupa et al., 2003; Tripathi et al., 2003). In this study, statistical methods were used to determine the effective yield factors (plant height, spike number/m2, spike height, spikelet number, seed number/spike, seed weight/spike, 1000 seed weight, test weight, harvest index and protein content) on grain yield in bread wheat genotypes and for this purpose, effective yield factors on grain yield were determined using path and biplot analyses methods.

MATERIALS AND METHODS

This research was carried out in 2020-2021 and 2021-2022 in the experimental area of Eskişehir Osmangazi University Faculty of Agriculture under arid conditions. In the 2020-2021 year when the experiment was carried out, a total of 363,7 mm of precipitation fand the average temperature was 10,4 ° C. In 2021-2022, a total of 385,7 mm of precipitation and the average temperature was 9,4 ° C. This amount of precipitation was determined to be slightly higher than the long-term average (361,45 mm). Again, the average temperature in both years was close to the long-term average (10.1 ° C). The experimental site soils are salt-free, contain 1,7% organic matter and 5,24% lime, and are clayey loamy and slightly alkaline in structure.

The experiment was carried out according to a randomized block design under arid conditions. Sowing was done on 15 October with a plot drill and the sowing density was applied as 0,22 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. Müfitbey, Altay, Nacibey, Es 26, Reis, Bayraktar, Bezostaja, Sönmez and Alpu genotypes were used as bread wheat

genotypes in the experiment. Plant height, spike number/m^2, spike height, spikelet number, seed number/spike seed weight/spike, 1000 seed weight, test weight, harvest index, protein content and seed yield. Path and biplot analyses of the average data obtained from the genotypes in the experiment were performed using Minitab 17, Tarist and Lisrel software programs.

RESULTS AND DISCUSSION

In wheat breeding, it is very important to evaluate the genetic material in terms of yield and quality components as well as yield in order to improve high yielding and high quality, stable in terms of quality and yield, and resistant to diseases. In this context, ten wheat genotypes used in the study; plant height, spike number/m2, spike height, spikelet number, seed number/spike, seed weight/spike, 1000 seed weight, test weight, harvest index and protein content were evaluated and effective yield components on grain yield were determined. The mean, maximum and minimum values of yield components examined on ten wheat genotypes tested in the study are given in Table 1.

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

Variable	Mean	Minimum	Maximum	Variable	Mean	Minimum	Maximum
Plant Height	85,68±3,79	67,84	103,81	**1000 Seed Weight**	37,41±1,46	24,43	40,13
Spike Number/m2	349,60±19,62	281,66	462,85	**Test Weight**	79,23±0,851	71,76	80,99
Spike Height	7,90±0,11	8,41	9,51	**Harvest Index**	41,54±1,36	29,71	46,54
Spikelet Number	13,64±0,31	11,37	14,04	**Protein Content**	12,34±0,39	10,26	14,09
Seed Number/Spike	31,46±1,31	24,43	36,76	**Seed Yield**	359,72±20,56	230,68	428,75
Seed Weight/Spike	2,03±0,05	1,89	2,35	±			

Correlation analysis between yield components is given in Table 1, path and biplot analysis revealing the components effective on yield are given in Table 1 and Figure 1a and b. Spike number/m^2, seed number/spike, seed weight/spike, test weight and harvest index had important relationship at %/1% with seed yield (Table 2). Path analysis revealed that spike number/m^2, spikelet number and seed number/spike via plant height; seed number/spike, seed weight/spike, test weight and harvest index via spike number/m^2; spike number/m^2, seed number/spike, seed weight/spike, harvest index via spike height; seed number/spike, harvest index, protein content

Table 2. Correlation analysis between yield elements and path and biplot analyses revealing the components that are effective on yield.

	Seed Yield	Plant Height	Spike Number/m^2	Spike Height	Spikelet Number	Seed Number/Spike
Plant Height	0.572**ns**					
Spike Number/m^2	0.778**	0.486**ns**				
Spike Height	-0.383**ns**	0.289**ns**	-0.579**ns**			
Spikelet Number	0.554**ns**	0.707*	0.444**ns**	0.100**ns**		
Seed Number/Spike	0.770**	0.324**ns**	0.661*	-0.559**ns**	0.661*	
Seed Weight/Spike	0.763*	0.158**ns**	0.638*	-0.639*	0.293**ns**	0.566**ns**
1000 Seed Weight	0.032**ns**	0.245**ns**	0.406**ns**	-0.375**ns**	0.328**ns**	0.192**ns**
Test Weight	0.761*	0.616**ns**	0.477**ns**	-0.128**ns**	0.634*	0.569**ns**
Harvest Index	0.638*	-0.038**ns**	0.610**ns**	-0.732*	0.347**ns**	0.839**
Protein Content	0.290**ns**	0.572**ns**	0.612**ns**	-0.158**ns**	0.612**ns**	0.438**ns**
	Seed Weight/Spike	**1000 Seed Weight**	**Test Weight**	**Harvest Index**		
1000 Seed Weight	0.293**ns**					
Test Weight	0.701*	0.169**ns**				
Harvest Index	0.649*	0.052**ns**	0.384**ns**			

Protein Content	0.071**ns**	0.698*	0.193**ns**	0.072**ns**

Dependent Variable: Seed Yield

For Plant Height			For Spike Number/m²		
Variables	**Path Coef.**	**%**	**Variables**	**Path Coef.**	**%**
Direct Effect	0.3393	19.6554	**Direct Effect**	0.5422	19.2812
Indirect Effects			**Indirect Effects**		
Via	**Path Coef.**	**%**	**Via**	**Path Coef.**	**%**
Spike Number/m²	**0.2634**	**15.2602**	**Plant Height**	0.1648	5.8612
Spike Height	-0.0600	3.4787	**Spike Height**	0.1204	4.2812
Spikelet Number	**0.1799**	**10.4244**	**Spikelet Number**	0.1131	4.0200
Seed Number/Spike	**0.2537**	**14.6988**	**Seed Number/Spike**	**0.5181**	**18.4229**
Seed Weight/Spike	0.0832	4.8216	**Seed Weight/Spike**	**0.3360**	**11.9494**
1000 Seed Weight	-0.0786	4.5543	**1000 Seed Weight**	-0.1304	4.6386
Test Weight	-0.1671	9.6787	**Test Weight**	-0.1293	4.5981
Harvest Index	0.0294	1.7045	**Harvest Index**	**-0.4673**	**16.6165**
Protein Content	-0.2714	15.7234	**Protein Content**	**-0.2905**	**10.3309**
For Spike Height			**For Spikelet Number**		
Variables	**Path Coef.**	**%**	**Variables**	**Path Coef.**	**%**
Direct Effect	-0.2078	9.3962	**Direct Effect**	0.2546	11.2583
Indirect Effects			**Indirect Effects**		
Via	**Path Coef.**	**%**	**Via**	**Path Coef.**	**%**
Plant Height	0.0981	4.4351	**Plant Height**	0.2398	10.6010
Spike Number/m²	**-0.3142**	**14.2108**	**Spike Number/m²**	0.2407	10.6437
Spikelet Number	0.0254	1.1489	**Spike Height**	-0.0207	0.9165
Seed Number/Spike	**-0.4381**	**19.8124**	**Seed Number/Spike**	**0.5184**	**22.9196**
Seed Weight/Spike	**-0.3365**	**15.2197**	**Seed Weight/Spike**	0.1541	6.8153
1000 Seed Weight	0.1205	5.4480	**1000 Seed Weight**	-0.1052	4.6501
Test Weight	0.0347	1.5710	**Test Weight**	-0.1718	7.5978
Harvest Index	**0.5608**	**25.3622**	**Harvest Index**	**-0.2657**	**11.7459**
Protein Content	0.0751	3.3956	**Protein Content**	**-0.2907**	**12.8519**
For Seed Number/Spike			**For Seed Weight/Spike**		
Variables	**Path Coef.**	**%**	**Variables**	**Path Coef.**	**%**
Direct Effect	0.7843	27.0315	**Direct Effect**	0.5269	22.0151
Indirect Effects			**Indirect Effects**		
Via	**Path Coef.**	**%**	**Via**	**Path Coef.**	**%**
Plant Height	0.1098	3.7832	**Plant Height**	0.0536	2.2398
Spike Number/m²	**0.3582**	**12.3454**	**Spike Number/m²**	**0.3459**	**14.4519**
Spike Height	0.1160	3.9997	**Spike Height**	0.1327	5.5454
Spikelet Number	0.1683	5.8008	**Spikelet Number**	0.0745	3.1131
Seed Weight/Spike	**0.2984**	**10.2859**	**Seed Number/Spike**	**0.4443**	**18.5642**
1000 Seed Weight	-0.0618	2.1293	**1000 Seed Weight**	-0.0940	3.9282
Test Weight	-0.1542	5.3134	**Test Weight**	-0.1901	7.9422
Harvest Index	**-0.6424**	**22.1418**	**Harvest Index**	**-0.4974**	**20.7825**
Protein Content	-0.2080	7.1691	**Protein Content**	-0.0339	1.4177
For 1000 Seed Weight			**For Test Weight**		
Variables	**Path Coef.**	**%**	**Variables**	**Path Coef.**	**%**
Direct Effect	-0.3211	21.2920	**Direct Effect**	-0.2710	12.4168
Indirect Effects			**Indirect Effects**		
Via	**Path Coef.**	**%**	**Via**	**Path Coef.**	**%**
Plant Height	0.0831	5.5092	**Plant Height**	0.2092	9.5824
Spike Number/m²	**0.2203**	**14.6092**	**Spike Number/m²**	**0.2587**	**11.8524**
Spike Height	0.0780	5.1693	**Spike Height**	0.0266	1.2200
Spikelet Number	0.0834	5.5314	**Spikelet Number**	0.1615	7.3968
Seed Number/Spike	**0.1509**	**10.0078**	**Seed Number/Spike**	**0.4461**	**20.4385**
Seed Weight/Spike	**0.1543**	**10.2295**	**Seed Weight/Spike**	**0.3695**	**16.9272**
Test Weight	-0.0458	3.0390	**1000 Seed Weight**	-0.0543	2.4872
Harvest Index	-0.0399	2.6467	**Harvest Index**	**-0.2941**	**13.4739**
Protein Content	**-0.3312**	**21.9658**	**Protein Content**	-0.0918	4.2050
For Harvest Index			**For Protein Cntent**		
Variables	**Path Coef.**	**%**	**Variables**	**Path Coef.**	**%**
Direct Effect	-0.7661	30.5859	**Direct Effect**	-0.4749	24.9694
Indirect Effects			**Indirect Effects**		
Via	**Path Coef.**	**%**	**Via**	**Path Coef.**	**%**
Plant Height	-0.0130	0.5202	**Plant Height**	**0.1939**	**10.1978**
Spike Number/m²	**0.3307**	**13.2044**	**Spike Number/m²**	**0.3318**	**17.4449**
Spike Height	0.1521	6.0717	**Spike Height**	0.0329	1.7274
Spikelet Number	0.0883	3.5253	**Spikelet Number**	0.1559	8.1965
Seed Number/Spike	**0.6577**	**26.2569**	**Seed Number/Spike**	**0.3436**	**18.0653**
Seed Weight/Spike	**0.3420**	**13.6551**	**Seed Weight/Spike**	0.0376	1.9794
1000 Seed Weight	-0.0167	0.6678	**1000 Seed Weight**	**-0.2240**	**11.7769**
Test Weight	-0.1040	4.1538	**Test Weight**	-0.0524	2.7547
Protein Content	-0.0340	1.3589	**Harvest Index**	-0.0549	2.8877

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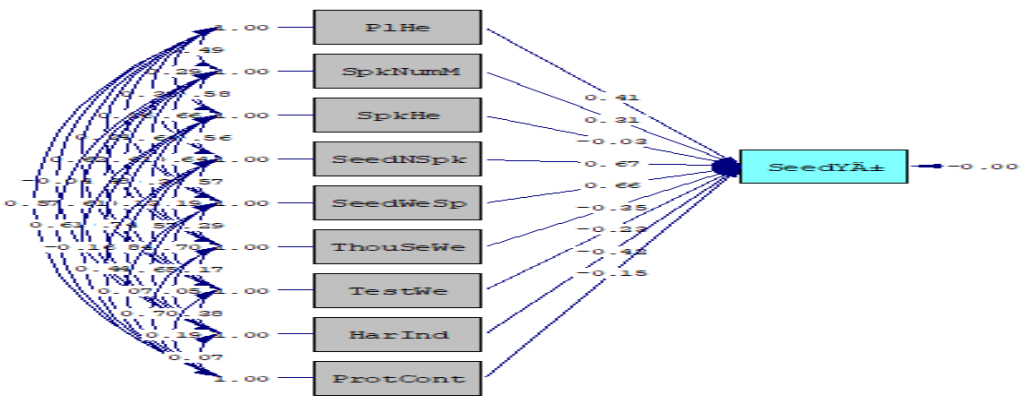

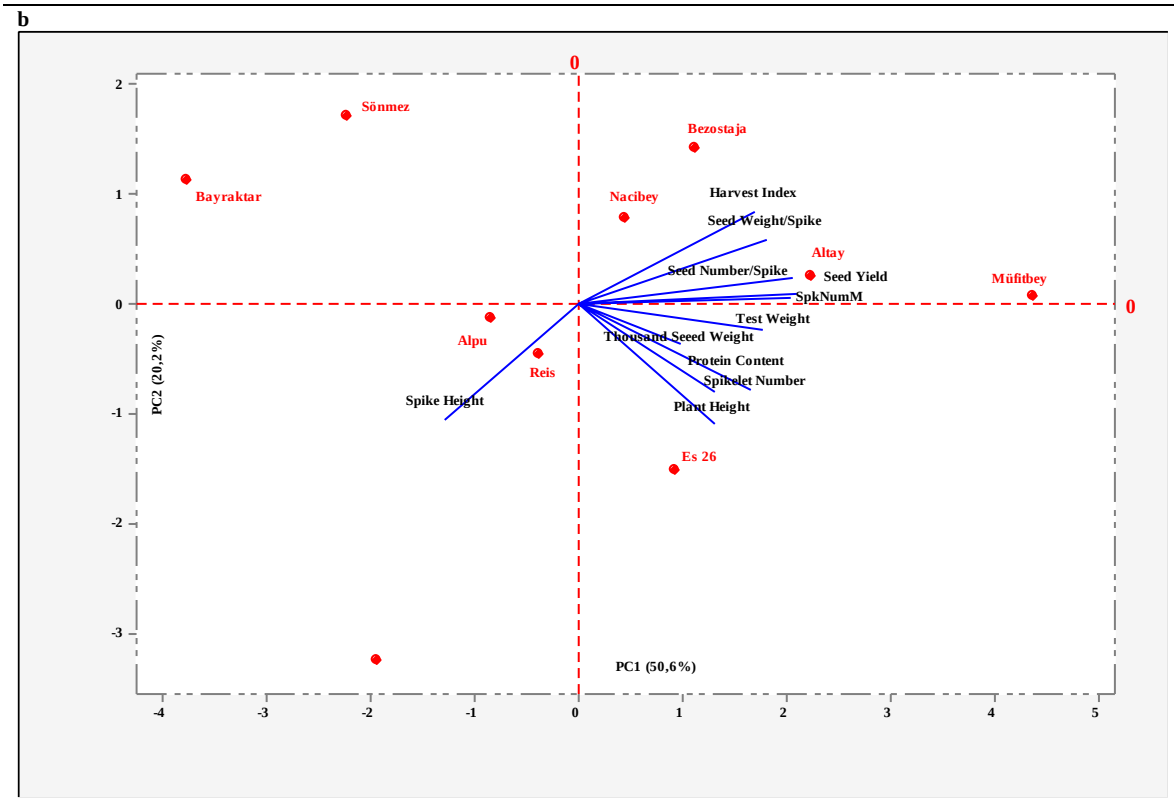

Figure 1. Path and biplot analyses showing the effect of yield components on seed yield.

via spikelet number; spike number/m^2, seed weight/spike, harvest index via seed number/spike; spike number/m^2, seed number/spike, harvest index via seed weight/spike; spike number/m^2, seed number/spike, seed weight/spike, protein content via 1000 seed weight; spike number/m^2, seed number/spike, seed weight/spike via harvest index; plant height, spike number/m^2, seed number/spike, 1000 seed weight via protein content were determined as important components on seed yield (Table 1 and Figure 1a).Correlation and path analyses revealed that spike number/m^2, seed number/spike, seed weight/spike and harvest index had important effect on seed yield in bread wheat. Biplot analysis revealed that spike number/m^2, seed number/spike, seed weight/spike and test weight were found as important factors on seed yield (Figure 1b).Besides, Müfitbey, Altay, Nacibey, Es 26 were high potential and stabile genotypes. Results denoted that spike number/m^2, seed number/spike, seed weight/spike and test weight are important components; Müfitbey, Altay, Nacibey, Es 26 were high potential and stabile genotypes.

REFERANCES

[1]. Anonymous, 2010, FAO, Global Agriculture Production 2010, http://www.fao.org.
[2]. Anonymous, 2019, FAO,Global Agriculture Production 2010, http://www.fao.org.
[3]. Atlı, A., Ozan, A., Özkara, R., 1992, Research on Malt Quality with Simple Analysis of Barley. 2nd Barley-Malt Seminar. 25-27 May, Konya: 122- 137.

[4]. Kün, E., 1983. Cool Climate Cereals A.U. Faculty of Agriculture Publications: 875 Text Book: 240, p:307.
[5]. Kün, E., Özgen, M., Ulukan, H., 1992, Research on quality characteristics of barley genotypes and lines. 2nd Barley Malt Seminar. 25-27 May, Konya. 373, p: 70-98.
[6]. Mehrotra, O.N., Sinha, N.S., Srivastava, R.D.L., 1967, Studies on nutrition of India cereals, I. uptake of nitrogen by wheat plants at various stages of growth as influenced by phosphorus, Plant and Soil, 26:361-368.
[7]. Prystupa, P., Slafer, G.A., Slavin, R., 2003, Leaf appearance, tillering and their coordination in response to NxP fertilization in barley. Plant and Soil, 255(2): 587-594.
[8]. Ryan, J. M., Mergoum, M., Gharous, M., 1991, Comparative triticale and barley responses to nitrogen at locations with varying rainfall in Morocco‟s Dryland Zone, Rachis: 3-7.
[9]. Tripathi S.C., Sayre K.D., Kaul, J.N. and Narang R.S., 2003, Growth and Morphology of Spring wheat Culms and Their Association with Lodging: effects of genotipes, N levels and ethephon. Field Crops Res. 84, 271–290.
[10]. Tripathi S.C., Sayre K.D., Kaul, J.N., Narang R.S., 2003, Growth and Morphology of Spring wheat Culms and Their Association with Lodging: effects of genotipes, N levels and ethephon. Field Crops Res. 84, 271–290.
[11]. Yanbeyi, S., Sezer, G., 2006, Samsun koşullarında bazı tritikale hatlarının verim ve verim öğeleri üzerine bir araştırma, OMÜ Zir. Fak. Dergisi, 21(1):33-39.
[12]. Yang, R.C. and Baker, R.J., 1991 Genotype and Environment Interaction in Two Wheat Crosses. Crop Sci. 31: 83-87.