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Research Article

İlhan ZİREK[1a]

Necat TOĞAY[1b*]

[1]Agricultural Engineer, VAN, Turkey

[2]Fethiye ASMK Vocational High School, Mugla S.K. University, Mugla, Turkey

[1a]**ORCID**: 0000- 0001-7120-1174

[1b]**ORCID**: 0000-0003-1052-1056

[*]Corresponding author:

necattogay@mu.edu.tr

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Determination of Yield and Some Yield Components of The Registered Dry Bean (*Phaseolus vulgaris* L.) Cultivars of Turkey in Van Conditions

Abstract
This study was conducted to determine cultivars which grown at Van Gürpınar ecological conditions and their some important agricultural and plant properties in 2013 year in center of Gürpınar. In the study was used 13 cultivars which officially registered such as Bulduk, Akın, Göynük, Karacaşehir 90, Arslan, Özdemir, Önceler, Battal, Zülbiye, Göksun, Akman 98, Akdağ and Güngör and 2 genotypes (Gevaş 1 and Gevaş 2). The trial was conducted by using randomized complete blocks design with the three replications. In the study were investigated sowing times on plant height, first pod height, numbers of branches, numbers of pod per plant and numbers of seed per plant, numbers of seed per pod, seed yield per unit area, harvest index, biological yield and 1000 seed weight. While the highest seed yield per area was obtained from Bulduk varieties with 360.4 kg da^{-1}, the lowest seed yield per area was obtained from Önceler with 201.6 kg da^{-1}.

INTRODUCTION

Animal-based foods have an important place in meeting the protein need (Çelim and Gülser, 2020). Unbalanced and malnutrition is one of the important problems in our country as well as in the world. It is increasingly important to feed the growing world population in a balanced way. Approximately 2/3 of the population in the world cannot get enough protein. It is necessary to get enough protein, carbohydrate and vitamins for a balanced diet. The plant stems are also a valuable animal feed as they contain plenty of protein. Dry Bean is one of the most important protein crops in Turkey (Toğay et al., 2004; Togay et al., 2008). Dry beans are an edible legume plant rich in vitamins A, B and D as well as having a high protein content of 19-31% (Adams et al., 1985). In addition, bean straw with a high protein content is an important source of roughage for our region, which is one of the livestock centers.

Edible grain legumes are in the Fabaceae family. The family is the largest of the flowering plant families (Özçelebi and Erman, 2021). Of the grain legumes grown for food, dry bean comes foremost on the global scale with 33.066 million ha of sowing area and 289.026 million tons of produce, whereas in Turkey, it ranks third with its 88.899 ha of sowing area and 225.000 tons of produce; the mean global yield is 87.4 kg ha^{-1}, whereas this parameter is 253.1 kg ha^{-1} for Turkey (Anonymous, 2019). Dry bean is a major crop grown on fine texture alkaline soils in Turkey.

Increasing the grain yield per unit area; It depends on the use of high-quality seeds of high-yielding, well-adapted varieties and the development of suitable growing techniques for these varieties. Increasing the production of edible legumes with the development of irrigation possibilities for the province of Van, which has a high fallow land, will undoubtedly contribute to the local people both economically and socially. Legume plants can benefit from the free nitrogen of the air by living in partnership with Rhizobium bacteria. Thus, the supply of nitrogen, which is one of the important factors limiting productivity in agriculture, is not a problem for legumes. In this way, the amount of nitrogen detected by beans every year is 50 kg ha^{-1} (Sepetoğlu, 1992). As the second product, beans provide nitrogen accumulation in the soil and increase in yield for the crops planted for winter after it.

This work area is registered in Turkey with some varieties of beans were grown extensively and the two genotypes yield for some performance characteristics are determined.

MATERIAL and METHODS

The research was conducted in Gürpınar district of Van. Thirteen registered bean varieties (Bulduk, Akın, Göynük, Karacaşehir 90, Arslan, Özdemir, Öneler, Battal, Zülbiye, Göksun, Akman 98, Akdağ and Güngör) and 2 local genotypes (Gevaş-1 and Gevaş-2) were used in the trials.

Gevaş 1: It is an early variety and its grain color is white, in the form of a rooster grain. It is a virus tolerant genotype that is resistant to bacterial diseases.

Gevaş 2: Gevaş 2 genotype is an early variety. The grain colors are white and the grain type is dermason. It is a virus tolerant genotype that is resistant to bacterial diseases.

Bulduk: It was registered by the Parade Zone Agricultural Research Institute in 2008. The color of the broad bean is light green and the grain skin color is white. It is resistant to bacterial diseases and tolerant to the virus.

Akın: Geçit Kuşağı was registered by TAE in 2009. Dwarf development nature, white color and the shape of a rooster.

Göynük: The Passage Zone was registered by TAE in 1998. Its development is stunted and steep. Flower color is white, grain type is rooster, grain color is white. It is a virus tolerant genotype that is resistant to bacterial diseases.

Karacaşehir-90: The Passage Zone was registered by TAE in 1990. It is a half-

wrapped variety. Flower color is white, grain type is small plump, grain color is white. It is a virus tolerant genotype that is resistant to bacterial diseases.

Arslan: It was registered by İTAŞ in 2008. It is an early variety with a dwarf nature, its grain color is white and dermason grain. It is a virus tolerant genotype that is resistant to bacterial diseases.

Özdemir: It was registered by İTAŞ in 2008. This type is semi-yellowing kidney bean type in the form of a violet colored grain on red brown.

Önceler: The Parade Zone was registered by TAE in 1998. Its development is stunted and steep. Flower color is light lilac, grain type kidney bean, grain color is variegated on beige background. It is tolerant to viral diseases and medium tolerant to bacterial diseases.

Battal: It was registered by İTAŞ in 2009. Its development is stunted and steep. Its grain color is beige. It is a summer and early variety. It is tolerant to viral diseases and medium tolerant to bacterial diseases.

Zülbiye: It was registered by the Black Sea Agricultural Research Institute in 2002. It is a summer variety with high yield. Seed color is white and its shape is rooster. It is a genotype that is not resistant to viral diseases but resistant to bacterial diseases.

Göksun: Eastern Mediterranean was registered by TAI in 2009. This type is early, semi-yellowish, grain color is white, grain shape is plump. It is a virus tolerant genotype that is resistant to drought and bacterial diseases.

Akman-98: Passage Zone was registered by TAE in 1998. It is a semi-yellowing, medium early variety. The grain color is white; the grain type is dermason. It is a virus tolerant genotype that is resistant to bacterial diseases.

Akdağ: It was registered by the Black Sea Agricultural Research Institute in 2002. It is a summer variety with high yield. Seed color is white and its shape is rooster. It is a genotype that is not resistant to viral diseases but resistant to bacterial diseases.

Güngör: It was registered by DAGKAE in 2006 through selection. Semi-yellowing, plant height 80-90 cm, flower color white, grain color white and 100-grain weight 60-65 g.

In the province of Van, Gürpınar district, Eastern Anatolia Region, Van center in the north, Başkale district in the east, Hakkari province in the south and Çatak district in the west are located in the province of Van where the research was conducted. The altitude of the district is 1752 m, and it is located at 380 19 'north latitude and 430 24' east longitude. Trial fields are located in the south east of Lake Van and 16-17 km from the lake edge. Terrestrial climate prevails in Gürpınar district of Van province.

Table 1. The average of Gürpınar district of Van for long years and some climate data for 2013

	Precipitation (mm)		Average temperature (^{0}C)		Relative humidity (%)	
Months	2013	Long term	2013	Long term	2013	Long term
June	8.6	18.6	18.9	18.2	44.6	49.3
July	0.0	5.0	23.3	22.3	34.9	44.1
August	0.0	3.3	21.5	21.9	40.1	42.2
September	8.7	13.8	17.4	17.2	36.4	44.1
Total	17.3	40.7				
Average			20.2	19.9	39.0	44.9

The winter season is cold and covered with snow, while the summers are cool and dry. Due to the fact that the district is close to the shore of Lake Van in terms of location and its plain extends to the lake, it is warmer than the inland parts with the positive effect of the lake. The fact that the soil surface is covered with snow during the winter months is an important factor in the reduction of cold damages in winter planting. The climate data for the months covering the period in which the experiment

was carried out and the average for long years are given in Table 1. In the region where the research was conducted, the annual precipitation amount related to the average of long years in the growing season is 40.7 mm, the average temperature is 19.9 ^{0}C, and the average relative humidity is 44.9%. The amount of rainfall in the 2013 growing season is 17.3 mm. Average temperature is 20.2 ^{0}C and average relative humidity is 39.0% (TSMS, 2013). Some physical and chemical analyzes of the soil samples taken from different depths of the soil where the experiment was established were made in Van Commodity Exchange Soil Plant Water Analysis Laboratory and the analysis results are given in Table 2.

According to the results of the soil analysis, it was determined that the soil samples taken from the research area have clayey-textured, slightly alkaline reaction, low organic matter content, high calcareous in terms of lime content, salt-free, and sufficient potassium content. Phosphorus content was found to be moderate (Table 2).

Table 2. Some properties of the <2 mm fraction of the top 20 cm of soil used for site

Soil properties	2011
Texture	Clay-loam
pH[A]	7.24
Clay (%)[B]	50.30
$CaCO_3$ (%)[C]	19.50
Olsen soil test P (ppm)[D]	3.46
Total salt (%)[E]	0.014
Organic matter (%)[F]	1.66

[A] 1 : 2.5 soil : water, [B] Bouyoucos (1951), [C] lime by calcimetric methods, [D] Olsen et al. (1954), [E] Richard (1954), [F] Jackson (1962)

According to the soil analysis results, it is seen that the soil of the trial area has clay-loam textured and lime content high. It was determined that the soil was salt-free in terms of salt content and neutral pH. It has been determined that in all layers of the soil, it is poor in terms of organic matter and nitrogen content, useful phosphorus content is less at 0-20 cm, and potassium is very low at the same depth.

The experiment was carried out in 2013 according to the randomized blocks design with three replications. There are a total of 45 parcels in the trial. Each parcel is 5 rows, in parcels it is 10 cm above the row and the distance between rows is 50 cm. A space of 2 m has been left between the parcel and the block. Parcel area; It has been arranged as 2.5 m x 4 m = 10.0 m². The amount of seed to be thrown into the parcel, equivalent to 40 seeds per m^2, has been determined (Şehirali, 1988). The plants in the 5 rows forming the plot in harvest, one row on each side and 50 cm from the plot heads were excluded as edge effects (Ceylan and Sepetoğlu, 1979). Measurements and weighting were made on an area of 1.5 m x 3 m = 4.5 m^2. Sowing, harvesting and threshing were done by hand. In the autumn of 2012, the trial area was driven deeply. In the spring of 2013, a second outcrop was tied, followed by a duplication by pulling a disc harrow and the seed bed was made ready for planting. The transplantation process was made manually by opening lines with a marker. 2-3 kg nitrogen and 5-6 kg da^{-1} phosphorus are sufficient in bean cultivation. DAP fertilizer was given to the soil at planting, equivalent to 15 kg per decare for the application plots. The planting process of the experiment was carried out on 01.06.2013 in one day. In the experimental area, weed control was done 2 times before and after flowering. The experiment was carried out under wet conditions, taking into account the rainfall, air temperature and humidity in the soil, 10

irrigations were carried out according to Şehirali (1988).

The measurement, counting and blending processes of the harvested plants were carried out with great care in the laboratory and the average values were taken. Plot yields were calculated by threshing the plants after drying in bunches. The effect of treatments on bean were analyzed using analysis of variance procedures in Randomized Blocks with the COSTAT statistical package. The means related with yield and yield components in bean were evaluated with Duncan's Multiple Range Test statistical analysis.

RESULTS and DISCUSSION

The values obtained in the study were subjected to variance analysis and the averages of the analyzed parameters were grouped according to Duncan Multiple Comparison (5%) Test.

The average plant height of bean varieties and genotypes used in the experiment varied between 40.0-251.6 cm (Table 3).

While the Arslan variety was the shortest with 40.0 cm, the difference between the Onceler, Zülbiye and Akman 98 varieties was found to be statistically insignificant. The tallest genotype is Gevaş 2 genotype with 251.6 cm. In some studies, on the subject, the plant height was reported by Güneş (2011) as 56.5–287.8 cm, and Pekşen and Gülümser (2005) as 17.70–103 cm. Although there is some similarity between the findings of the researcher and the findings obtained, there are some differences. The reason for this is thought to be due to climatic conditions. Karadeniz and Togay (2009) reported that the average plant height of lentil varieties ranged from 27.93 to 35.13 cm. Plant height is affected by the hereditary characteristics of the plant and environmental factors. While bean varieties grown under the same conditions can show different plant height values, the same varieties can create different plant sizes with different applications.

Table 3. Average plant height of bean varieties and Duncan groups (cm)*

Varieties	Means
Bulduk	114.6 c
Akın	55.3 g
Göynük	51.9 gh
Karacaşehir 90	71.0 e
Gevaş 1	222.5 b
Gevaş 2	251.6 a
Arslan	40.0 k
Özdemir	61.6 f
Önceler	43.0 jk
Battal	50.0 hi
Zülbiye	46.3 ij
Göksun	71.6 d
Akman 98	49.3 hi
Akdağ	45.3 ij
Güngör	90.3 d

* Values belonging to the same letter group are not different according to Duncan 5%

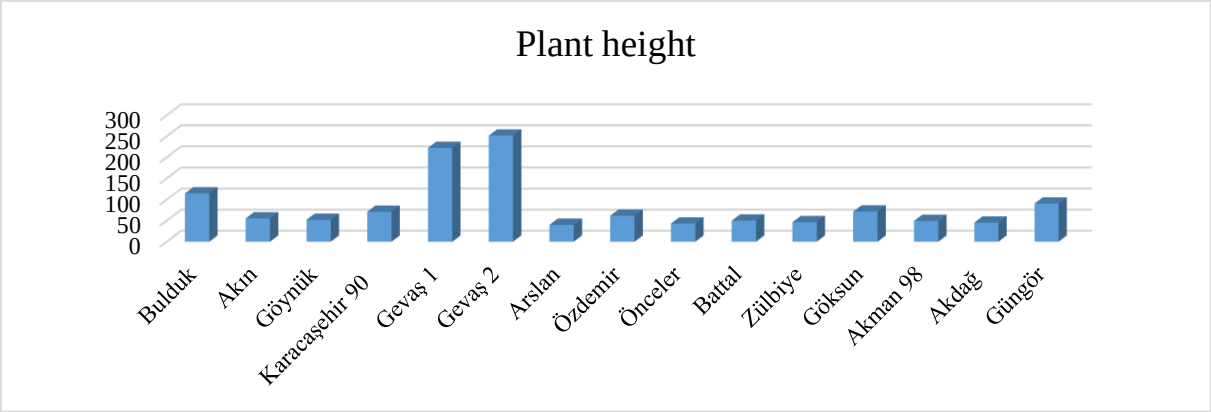

Figure 1. Plant heights of bean varieties

When the variance analysis results are examined, it is seen that there are significant differences at the level of 1% between varieties in terms of number of branches (Table 4). The average number of branches of bean varieties and genotypes used in the study varied between 5.90-2.23. While Özdemir variety showed the lowest average number of branches with 2.23 pieces, the difference between Önceler, Battal varieties and Gevaş 1 and 2 genotypes was found to be statistically insignificant. Bulduk variety was the variety with the highest average number of branches with 5.90. Önder and Şentürk (1996a), who conducted research on this subject, determined the number of branches of the cultivars as 4.11-4.66 under the ecological conditions of Karaman. The findings obtained are parallel to the findings of the researchers. Although the amount of branching varies according to the varieties, when optimum conditions are provided for the plant, it is seen that branching is at the optimum level like the other organs of the plant.

Table 4. Average number of branches belonging to bean varieties and Duncan groups (number plant^{-1})*

Varieties	Means
Bulduk	5.90 a
Akın	3.23 de
Göynük	3.66 bc
Karacaşehir 90	3.03 ef
Gevaş 1	2.53 gh
Gevaş 2	2.50 gh
Arslan	2.76 fg
Özdemir	2.23 he
Önceler	2.50 gh
Battal	2.46 gh
Zülbiye	3.90 b
Göksun	3.36 d
Akman 98	3.26 de
Akdağ	3.40 cd
Güngör	3.23 de

* Values belonging to the same letter group are not different according to Duncan 5%

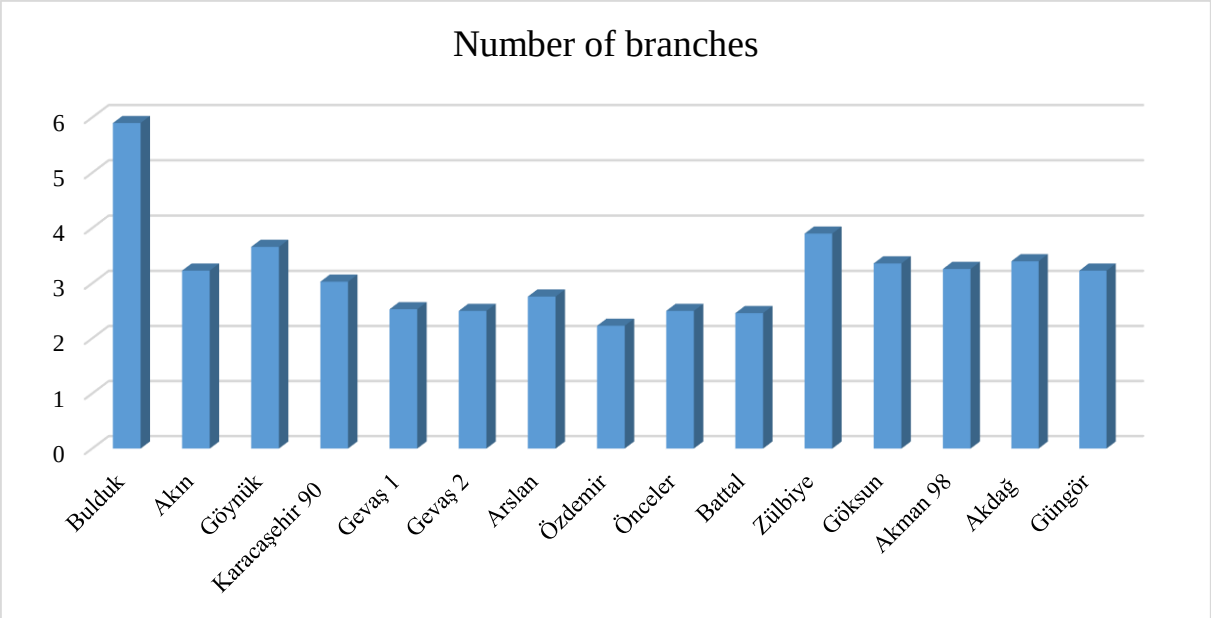

Figure 2. Number of branches of bean varieties

When the variance analysis results in Table 5 are examined, it is seen that there are significant differences in terms of the number of pods per plant at the level of 1% between the varieties. The average number of pods per plant of the bean varieties and genotypes used in the study varied between 8.83 and 25.96. While Özdemir variety had the lowest average number of pods with an average of 8.83 pods, Bulduk variety had the highest pod number with 25.96 pods. Pekşen and Gülümser (2005), in their studies with some bean genotypes, determined the number of pods between 4.5-25.8 units / plant.

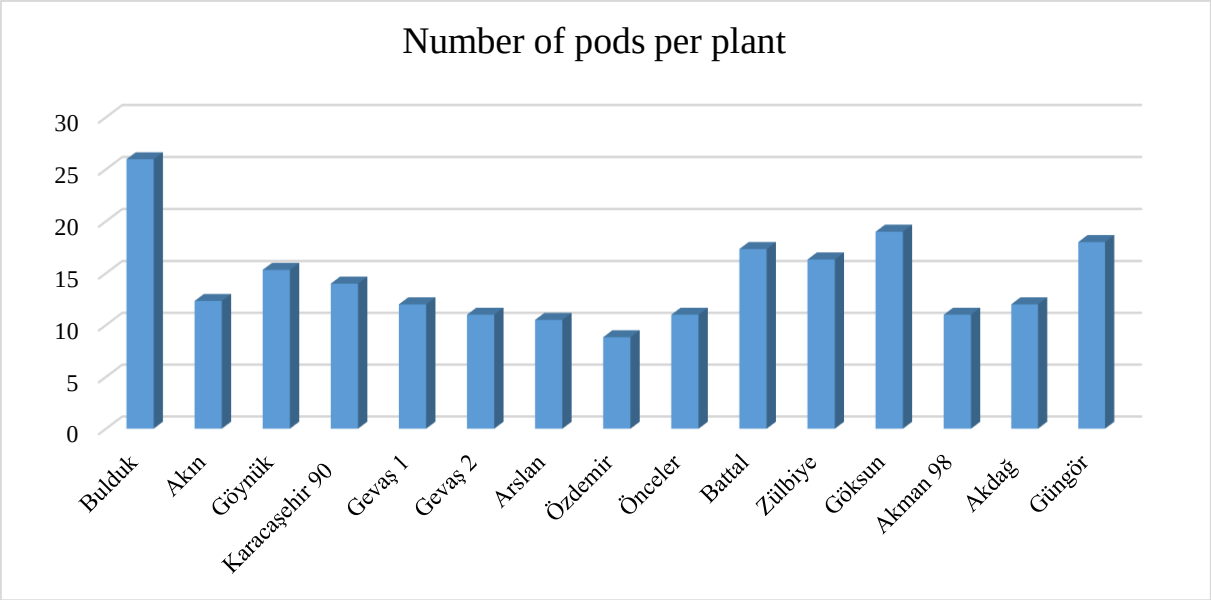

Figure 3. Number of pods per plant of bean varieties

Table 5. Number of pods per plant belonging to bean varieties and Duncan groups f (number plant^{-1})*

Varieties	Means
Bulduk	25.96 a
Akın	12.33 g
Göynük	15.33 ef
Karacaşehir 90	14.00 f
Gevaş 1	12.00 gh
Gevaş 2	11.00 gh
Arslan	10.50 h
Özdemir	8.83 i
Önceler	11.00 gh
Battal	17.33 cd
Zülbiye	16.33 de
Göksun	19.00 b
Akman 98	11.00gh
Akdağ	12.00 gh
Güngör	18.00 bc

* Values belonging to the same letter group are not different according to Duncan 5%

The average number of grain per plant of bean varieties and genotypes used in the study varied between 96.86-32.10. With the average number of grain in 32.10 plants, Özdemir variety was the variety with the lowest average, while the difference between the Önceler variety was found to be statistically insignificant. Bulduk variety has the highest average number of seeds per 96.86 plants. The results found are compatible with 57-113 numbers / plant of Fırtına (2006) and some results of 20-123.1 numbers plant^{-1}of Deniz (2008).

Table 6. Number of seeds per plant belonging to bean varieties and Duncan groups (number plant^{-1})*

Varieties	Means
Bulduk	96.86 a
Akın	43.96 fg
Göynük	61.83 d
Karacaşehir 90	53.00 e
Gevaş 1	42.03 fgh
Gevaş 2	36.30 hi
Arslan	37.43 ghi
Özdemir	32.10 i
Önceler	33.40 i
Battal	71.03 c
Zülbiye	63.16 d
Göksun	77.86 b
Akman 98	36.76 ghi
Akdağ	42.80 fgh
Güngör	48.03 ef

* Values belonging to the same letter group are not different according to Duncan 5%

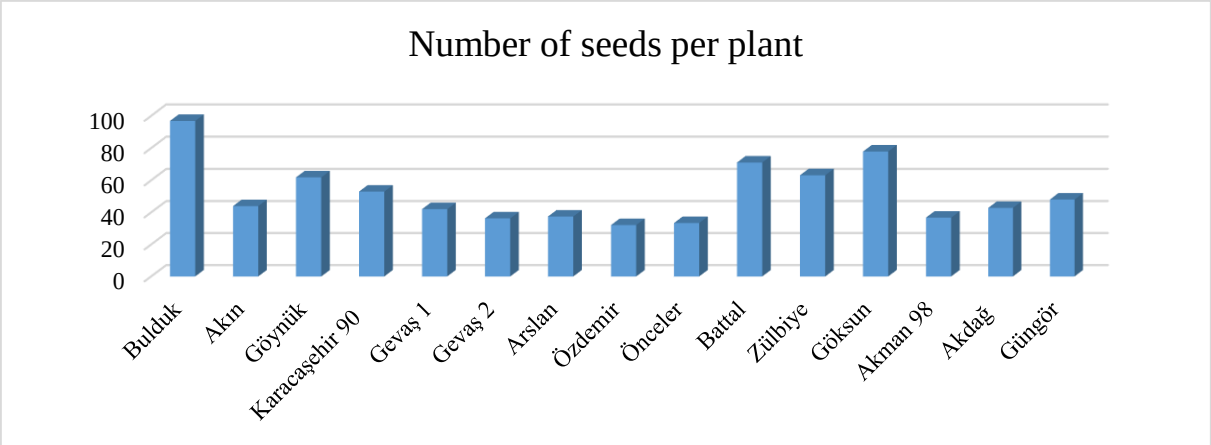

Figure 4. Number of seeds of bean varieties

Table 7. Biological yield averages of bean varieties and Duncan groups formed (kg da^{-1})*

Varieties	**Means**
Bulduk	891.9 a
Akın	652.7 e
Göynük	827.0 b
Karacaşehir 90	596.2 f
Gevaş 1	721.8 cd
Gevaş 2	749.5 c
Arslan	797.9 b
Özdemir	820.7 b
Önceler	593.1 f
Battal	912.7 a
Zülbiye	595.3 f
Göksun	737.0 c
Akman 98	696.8 d
Akdağ	637.5 e
Güngör	531.8 g

* Values belonging to the same letter group are not different according to Duncan 5%

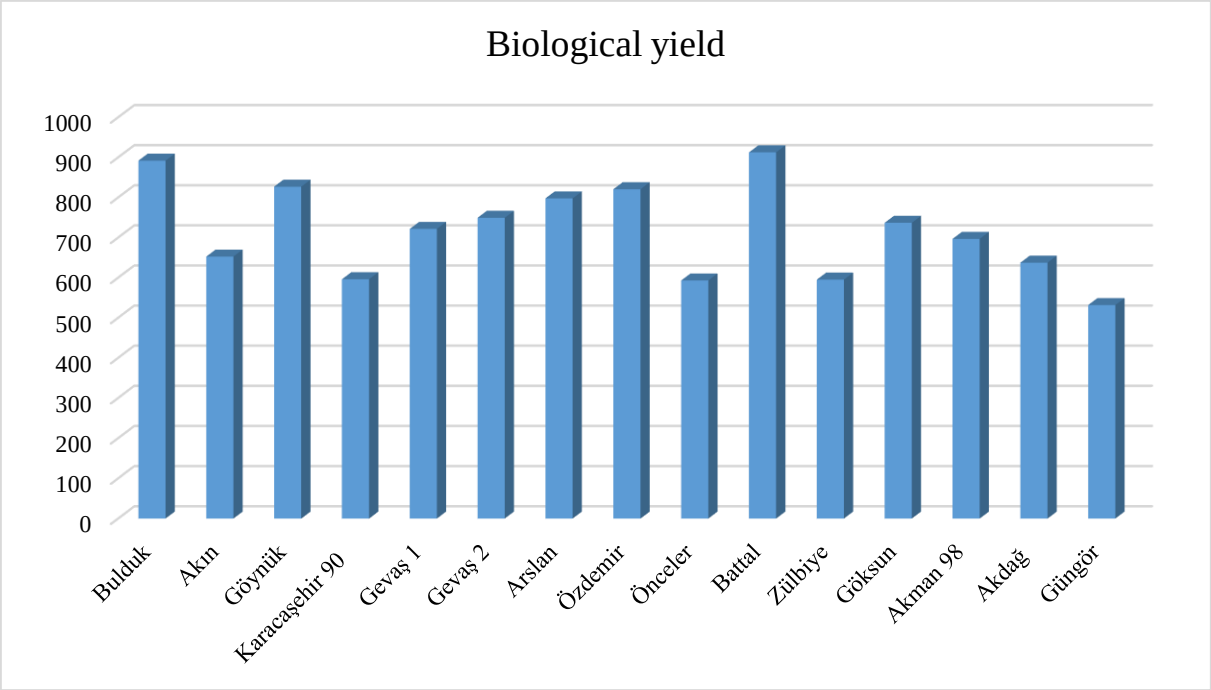

Figure 5. Number of seeds of bean varieties

Biological yield average values of bean cultivars and genotypes used in the experiment varied between 912.7-593.1 kg da^{-1} The lowest biological yield value was obtained from the Öneler variety and the difference between the Karacaşehir 90 variety was insignificant, while the highest biological yield value was obtained from the Battal variety, but the difference with the Bulduk variety was found to be statistically insignificant. Bozoğlu (1995) stated that well-kept plants will give higher biological yield and consequently the grain yield increases. When the variance analysis results in Table 8 are examined, it is seen that there are significant differences at the level of 1% between the varieties in terms of grain yield per unit area. The average grain yield per unit area of bean cultivars and genotypes used in the experiment varied between 360.3-201.6 kg da^{-1}. Önceler variety has the lowest average grain yield with an average of 201.6 kg ha^{-1} unit, and the difference between Güngör variety was found to be statistically insignificant. Bulduk variety has the highest average grain yield per unit area of 360.3 kg da^{-1}. Togay et al. (2008) reported that they found the highest grain yield of 160.6 kg da^{-1} in the study of sulfur and phosphorus fertilization in beans they conducted in the center of Van. Our findings are similar to those of Gülümser and Özçelik (1988).

Table 8. Average of grain yield per unit area of bean varieties and Duncan groups formed (kg da^{-1})*

Varieties	Means
Bulduk	360.3 a
Akın	241.6 g
Göynük	320.0 c
Karacaşehir 90	212.6 j
Gevaş 1	231.0 hi
Gevaş 2	238.3 gh
Arslan	286.6 d
Özdemir	276.3 e
Önceler	201.6 k
Battal	337.6 b
Zülbiye	222.3 i
Göksun	254.6 f
Akman 98	227.6 i
Akdağ	231.6 hi
Güngör	205.6 jk

* Values belonging to the same letter group are not different according to Duncan 5%

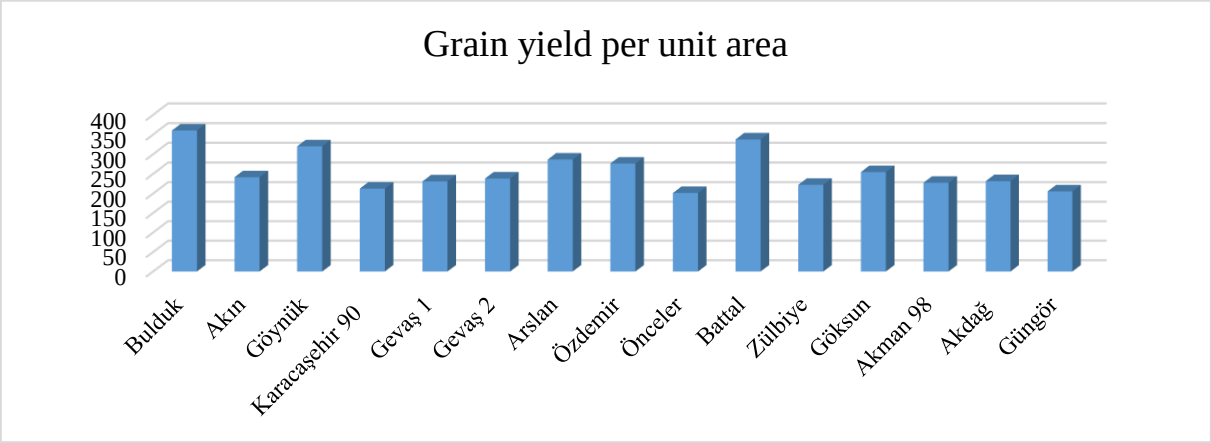

Figure 6. Average of grain yield per unit area of bean varieties

Table 9. One thousand grain weight averages of bean varieties and Duncan groups formed (g)

Varieties	Means
Bulduk	483.2 c
Akın	389.0 g
Göynük	399.6 ef
Karacaşehir 90	175.0 l
Gevaş 1	331.0 hi
Gevaş 2	337.0 h
Arslan	391.6 fg
Özdemir	482.3 c
Önceler	276.0 k
Battal	621.0 a
Zülbiye	441.6 d
Göksun	323.0 i
Akman 98	285.0 j
Akdağ	402.6 e
Güngör	572.3 b

* Values belonging to the same letter group are not different according to Duncan 5%

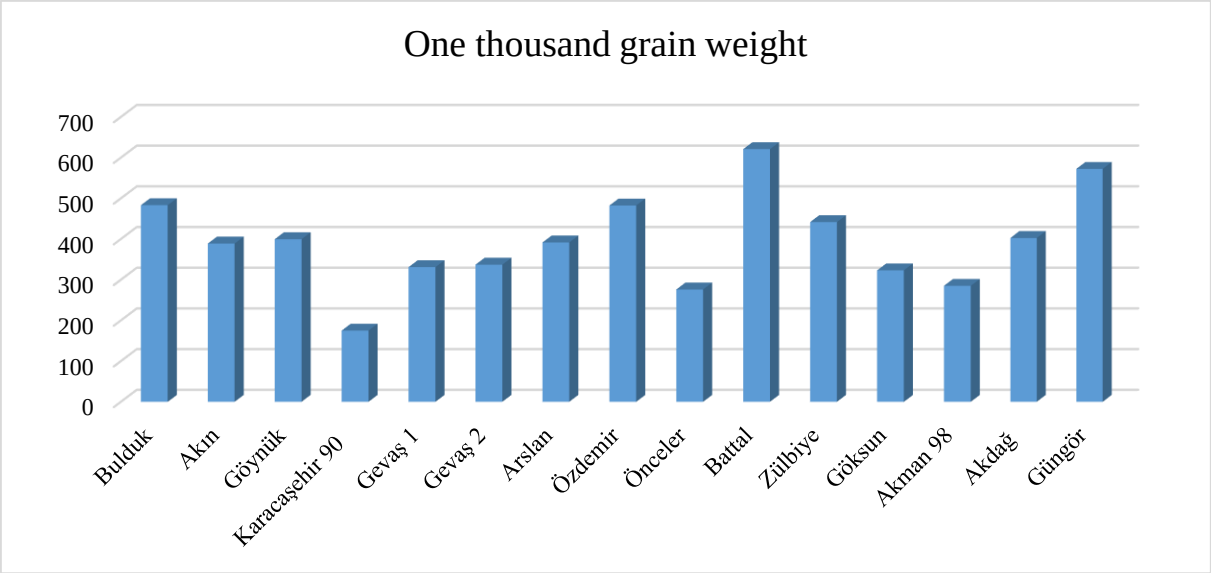

Figure 7. One thousand grain weight per unit area of bean varieties

The average thousand kernel weight of bean varieties and genotypes used in the study varied between 621.0- 276.0 g. While the former variety had the lowest thousand grain weight with an average of 276.0 g thousand grain weight, the highest thousand grain weight average was obtained in Battal variety with 621.0 g. Bozoğlu and Gülümser (1999) obtained a thousand grain weight between 159.58–520.93 g in Samsun ecological conditions. These results seem to be in agreement with our findings.

CONCLUSION

In this study, it was aimed to determine the variety and adaptation characteristics of some bean varieties and genotypes in Van Gürpınar conditions. The experiment was established with 3 replications according to the randomized blocks trial design and 13 varieties and 2 genotypes were used in the experiment. While the highest seed yield per area was obtained from Bulduk varieties with 360.4 kg da^{-1}, the lowest seed yield per area was obtained from Önceler with 201.6 kg da^{-1}. As a result of the research, Bulduk variety was superior in terms of all yield characteristics in Van Gürpınar ecological conditions.

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